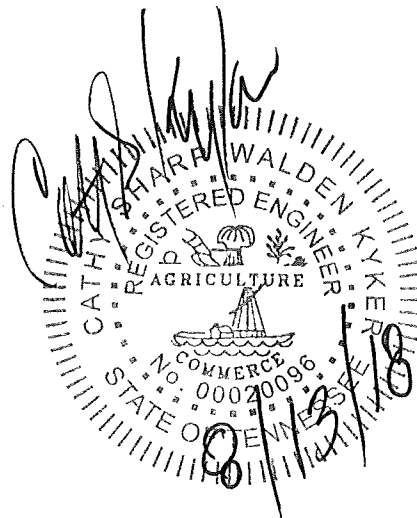


**TECHNICAL SPECIFICATIONS  
FOR  
2017 GREENEVILLE WASTEWATER TREATMENT  
PLANT IMPROVEMENTS, UV SYSTEM  
2017 CDBG PROJECT - CONTRACT # 53789-12010  
GREENEVILLE, TN**

**#18-02**

**JULY 2018**



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## **SECTION 1000 - GENERAL**

### ***CONTRACT DOCUMENTS:***

The work shall be executed in accordance with the specifications, addenda, and the plans.

### ***FUNDING:***

This project is being funded with a Community Development Block Grant. Their regulations must be followed.

### ***SCOPE OF WORK:***

The work included under these specifications and the accompanying drawings consists of providing all items, articles, materials, operation, or methods listed, mentioned, or scheduled on the drawings and/or herein including all labor, materials, equipment, services, and incidentals necessary for their completion.

The intent of this contract is to upgrade the Town of Greeneville's Wastewater Treatment Plant by constructing a new ultraviolet disinfection system. The work includes construction of concrete channels, installation of the UV equipment, piping, electrical controls, generator, cover for equipment, grading, and other related work as detailed in the Technical Specifications and Construction Drawings or listed in the bid schedule.

The contractor will be responsible for keeping the existing plant operational during construction and prevent any sewer overflows. The contractor shall be fully responsible for any fines or regulatory action if such overflows occur. The contractor may have to incorporate bypass pumping or temporary piping or other means necessary to prevent overflows. The temporary piping shall be of sufficient size to handle peak flows without any adjustment or aid of plant staff. All hauling costs, bypassing pumping costs, temporary piping, etc. including any necessary labor and equipment is the responsibility of the Contractor and will not be considered for direct payment. Prior to initiation of construction the Contractor shall submit a plan of action to the Engineer for approval of how the sewage and plant will be managed during construction and an outline of the sequence of work. The plan should include projected time frames.

All work and materials necessary to connect any new motors or components added in this project, existing motors, outlets, lights, meters, or other components of the plant that has power requirements shall be reconnected or connected to the electrical system even if not specifically mentioned.

All equipment included in these specifications or as shown on the drawings, shall be furnished

complete, installed and operational. All materials and accessories needed to be operational, secured, adequately supported and installed per manufacturer's recommendations shall be furnished even if not specifically mentioned.

The contractor shall furnish two aluminum angles (minimum of 3" x 3" x ¼") to be mounted adjacent to or on structures using non-corrosive anchors for all equipment control panels, disconnects, etc. as needed for equipment unless otherwise shown.

Any metal surfaces in contact with or adjacent to wastewater shall be coated with paint or be non-corrosive even if not specifically mentioned.

#### *ALTERNATES - BID DEDUCTS:*

Some items shown may be deducted from the contract if funds are not available. They will be deducted in the order listed.

Alternate #1 – Deduct cover over UV unit. This will include the structure only (columns, metal roofing, etc.). The concrete footings will still need to be installed as shown.

Alternate #2 and Alternate #3 will be for other brands of UV equipment system. This shall include the deduct in price for the alternate brand of equipment. It shall include the complete costs including any modifications required for the structure, flow control, etc. See section 11200 for more information.

Since the brand of alternate equipment will be evaluated after bids are taken the bidder can submit 2 (or more) alternate brands for consideration. Obviously, both of these alternates would not be selected by the owner. Even if the price of an alternative brand is lower the owner may not select the alternative based on other criteria.

#### *SPECIFIED MATERIALS / SUBSTITUTIONS:*

Names of manufacturers and model numbers (when used in these specifications or on drawings) are used as general descriptive references and are referenced to establish a standard for product. Equipment and products of equal quality and performance will be acceptable. The Contractor may recommend the substitution of any material, equipment, or article which he thinks is equal in every area to that specified. If, in the opinion of the Engineer, such item is of equal quality and performance of that specified, the Engineer may approve its substitution for use. Reputation of manufacturer, past performance and service, number of years product has been manufactured, and location of service centers and other things will be considered in evaluation of product.

#### *ALTERNATE BRANDS:*

Much research was spent in selecting the brand of the UV equipment specified. The

structural, civil and electrical designs were based on the dimensions and features of this brand. The owner wishes to consider other brands that are of same quality and performance. If an alternate is "equal" in performance it may require redesign of channel design, alteration to site plan, etc. and may impact the overall cost of the project. The contractor will be responsible for any such redesign and any additional associated cost by using an alternate brand. Any of these related costs must be included in the "alternate brand costs".

#### *EXISTING UTILITIES:*

Efforts have been made to identify existing utilities in the construction area. However, some existing utilities may not be shown in actual location or may not be shown. Existing utilities shown on drawings are shown in approximate location only. Contractor is responsible for location of all existing utilities whether shown on drawings or not. Contractor shall notify Tennessee One Call (1-800-351-1111) to locate and notify all utility companies with existing utilities in the project area prior to any excavation. Contractor is responsible for following their procedures for crossing, repair, etc. of such utilities. However, the lines on site belonging to the Owner will not be marked in response to one-call. They are shown based on old construction drawings. Locations and elevations are approximate. Contractor is to excavate and find exact locations and depths far enough ahead of work so adjustments can be made as necessary to reduce or eliminate conflicts. No additional payment will be made for necessary adjustments.

#### *ELEVATIONS AND GRADES:*

Elevations and grade lines shown on the drawings indicate the height in relation to top of aeration basin walls as noted on the drawings.

The words "finished grades" as used herein refers to the required final grade elevations indicated on the drawings. Should finished grades shown by spot elevations conflict with those shown by contours, such discrepancies shall be referred to the Engineer for adjustment before any work affected thereby is performed.

The Contractor shall assume responsibility for installation and protection of bench marks, monuments, and other reference points needed for construction. The Contractor shall replace, as directed, any reference points removed or destroyed during construction.

#### *REGULATORY REQUIREMENTS:*

All work in project shall meet requirements of Tennessee Department of Environment & Conservation and local requirements for materials and installation of the work. In addition, the work shall conform to applicable state and local building codes, conform to Fire Protection NFPA 72, conform to Electrical Code NFPA 70, and Life Safety Code NFPA 101.

#### *PROJECT RECORD DOCUMENTS:*

During construction contractor shall accurately record location of pipe runs, connections, pumps, other utilities, etc. At the end of the project these "record drawings" shall be submitted to the Owner.

#### *ABBREVIATIONS:*

Abbreviations of standards, codes, and publications used within these specifications are as follows:

ANSI	American National Standards Institute
ASTM	American Society of Testing Materials
AWWA	American Water Works Association
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriter's Laboratory, Inc.

#### *PERMITS AND INSPECTIONS:*

Unless otherwise distinctly hereinafter specified, this Contractor shall apply and pay for all necessary permits, fees and inspections required by any public authority having jurisdiction. Acreage charges, bonds, property assessments and facilities charges shall not be construed to be a part of this contract.

#### *TRAFFIC CONTROL:*

The Contractor is responsible for traffic control on the project as applicable. The contractor is required to furnish, erect, and maintain a sufficient number of standard construction warning signs and traffic control devices as may be required for the protection of the general public and construction personnel. The number, location, type, and site of these construction warning signs shall conform to applicable federal, state, and local agencies governing roadways in the project area. Contractor shall also follow "The Manual on Uniform Traffic Control Devices for Streets and Highways" published by the Federal Department of Transportation.

#### *SHOP DRAWINGS:*

The Contractor shall submit six (6) copies of the shop drawings to the Owner prior to construction.

Shop drawings shall be submitted on all materials used on this project. All submittals shall have signatures by the Contractor certifying that they have reviewed and approved the

submittals prior to submission to the Engineer. Each material proposed for use shall be a standard catalog product of an established manufacturer. The shop drawing submittals shall include sufficient information on material to evaluate and compare it to brand of material specified. Any differences from brand specified shall be noted. Each submittal shall include manufacturer's name, material's intended use, performance criteria, location of manufacturer, location of service center (if applicable), sales representative's name and phone number, contractor's name, dimensions, options available and options included. On major equipment, submittals shall include references and list of recent installations with contact persons and phone numbers. Approval of shop drawings shall not be considered as a guarantee that material will fit site conditions. Any substitute of material shall be reviewed by contractor to determine if actual building conditions and other materials used on job will be compatible with substituted material. Shop drawing approval does not mean that drawings have been checked in detail; said approval does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the contract drawings and specifications.

If applicable, all equipment submittals shall include information on conduit seal fittings, wiring devices, disconnect switches, UL design for sealing penetrations, control diagrams, wiring diagrams, description of control systems, maintenance and calibration information, information on pumps, enclosures, hatches, locks, etc..

#### *PROTECTION OF PROPERTY AND PERSONS:*

The Contractor is cautioned that in many areas, limited working room is available. Therefore, special precautions must be taken by the Contractor.

The Contractor shall thoroughly document the existing condition of all structures, landscaping, and improvements located in all locations of the construction work. Documentation shall be done using video camera and photographs. Documentation shall be submitted to Engineer prior to the first pay estimate. The documentation will be used to help settle any disputes which may arise. This documentation shall be submitted to the Engineer prior to the first payment estimate.

Reasonable care shall be taken during construction to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be rimmed of those branches to improve the appearance of the tree. Tree trunks receiving damage from equipment shall be treated with a tree dressing. All disturbed areas shall be restored to their original condition.

The Contractor shall take every effort to protect public streets, curbs, and utilities from damage from the Contractor's operations. Plan work to avoid ponding, flooding, and erosion on site and upon adjacent property. Care shall be taken to avoid obstruction of flow of natural runoff.

Contractor shall provide and install bracing and shoring required to prevent cave-ins.

The contractor shall provide and maintain all pumping equipment necessary to keep excavations free of water. Water shall not be directed onto adjacent property.

Blasting work shall be done with licensed personnel and done in accordance with applicable regulations. Any required rock blasting shall be performed using the minimum practical charges. Care shall be taken to protect persons and property from damage. In areas where blasting is to be done near existing structures, pre-blast surveys shall be performed.

#### *EXCAVATIONS:*

The Contractor shall take special precautions when performing excavations to avoid damage to any existing lines or to other structures at the site. Furthermore, if the contractor encounters the remains of humans, artifacts, anything with historical or archaeological, or other material, which may require examination, the construction shall be stopped and the Engineer and owner notified immediately.

When all work is complete, the site is to be restored, cleaned up and reseeded as applicable.

See section 2200 for additional information related to excavations, foundations and earthwork.

#### *SILTATION AND SOIL EROSION:*

Siltation and soil erosion must be minimized during construction. Refer to Section 2260 of these specifications.

#### *CLOSE-OUT OF PROJECT:*

Prior to release of all retainage, the Contractor must notify owner so that proper publication can be made. In addition, the project must be fully complete. This includes seeding, asphalt repair, testing of lines, receipt of O&M manuals for major equipment, etc. The Contractor must furnish to the Owner "Release of Liens" from all suppliers and subcontractors. Furthermore, a "Consent of Surety" must also be furnished.

When requested by the Contractor, one review of the project will be made by the Engineer to develop a punch list. The Contractor is to notify the Engineer in writing when ALL punch list items have been completed. The Engineer and the Owner will then make an inspection. If more than one inspection is required because of the Contractor's failure to correct all deficiencies in the work, the Contractor will be responsible for payment to the Owner for fees charged by the Engineer for additional inspections.



#### *WARRANTY:*

The contractor shall warranty the complete project (Including asphalt repair, seeding, etc.) for a period of one year after final acceptance of the project by the Owner. Additional warranties for some of the equipment may be specified to be longer. During that period, any warranty work identified will be reported to the Contractor. If the work is an emergency (in the opinion of the Owner) or if the Contractor fails to do warranty work in a reasonable time, the Owner may hire the work done and bill the Contractor. This may include "punch list" work if not performed by the Contractor in a reasonable time and the costs may be deducted from the Retainage. "Reasonable time" will be determined by Engineer and Owner.

*END OF SECTION 1000*

## **SECTION 2200 – FOUNDATION AND EARTHWORK**

### **PART 1 – GENERAL:**

***Refer to structural drawings for additional information. The notes on the structural drawings shall govern in the case of any discrepancies between the structural drawings and these specifications.***

### **SCOPE:**

This section describes the work to be done related to the grading and site work for a UV Disinfection System including concrete channels, piping, cover, electrical, generator, and other components of the wastewater treatment plant project. The contractor is to furnish all materials, labor, equipment, permits and other items necessary for the grading and site work described in these specifications and/or as shown on drawings.

This project includes:

- Site layout

- Perform mass excavation and embankment as shown on drawings.

- Geo-technical and Soil testing as required.

- Fine grading for structures and concrete areas.

- Stockpile, furnish, spread, and fine grade topsoil over all areas to be landscaped.

- Install and maintain Erosion control during all grade work and construction.

- Gravel placement, concrete placement for sidewalks, structures and pads.

- Ditches, storm drains, and other storm drainage components as outlined on drawings.

### **ELEVATIONS:**

Elevations and grade lines shown on the drawings indicate the height in relation to a benchmark set at the site. Should grades shown be in conflict with those identified at the site, such discrepancies shall be referred to the Engineer for adjustment before any work affected is performed.

The contractor shall assume responsibility for protection of benchmarks, property corners, and other reference points. The contractor shall replace any reference points removed or destroyed during construction.

#### *PROJECT EROSION AND SILTATION CONTROL:*

All site work must be done in accordance with the State of Tennessee regulations regarding erosion and siltation control. The Contractor is responsible for construction, implementation, and maintenance of erosion and siltation control of project site. The plan shall be continuously implemented to effectively control erosion and siltation during the term of the contract. The contractor is to routinely check and make modifications to the erosion control devices as necessary until the project is complete and permanent measures to control erosion and siltation are in place. The Contractor will be responsible for any fines or damages resulting from erosion and siltation from project site should any result. It is anticipated that less than 1 Acre will be disturbed for this project so a NOI and SWPPP will not be necessary. Refer to Section 2260 for additional information.

#### *GEO-TECHNICAL REPORT:*

A Geo-technical report has not been completed for this project. However, once excavations for any structure, foundations or slab are excavated, a geo-technical engineer shall be hired by the contractor to observe and test the subgrade to determine it is suitable prior to any placement of stone or concrete. In addition, for fill areas the fill material and the compaction methods must be approved by a geo-tech engineer. The fill compaction shall be tested by geo-tech representative and written reports submitted to Engineer. The sub-grade for any structure (in both fill and cut areas ) shall be reviewed by the geo-tech engineer approved in writing prior to placement of any stone or concrete. The geo-technical engineer shall be licensed in Tennessee and shall be approved by Engineer and Owner prior to completing any work on the project.

#### *PART 2 – MATERIALS:*

##### *ROADWAYS*

Stone, concrete and related materials shall meet Tennessee Department of Transportation standard specifications for Road and Bridge construction and as specified on the drawings.

##### *CONCRETE*

All concrete shall be 4,000 psi compressive strength (unless otherwise noted on drawings) and shall be placed per ACI requirements.

Concrete Pad : There will be concrete pads as shown on drawings with 4,000 psi concrete, a 4" compacted stone base, a 6-mil poly vapor barrier, and control joints for equipment. The concrete pads will be sealed with 1 coat of Kure-N-Seal 30% Solids, or equal. The concrete pad(s) will have sawn control joints if larger than 10'. The perimeter of the concrete pads shall be below finish grade. The pads will have a broom finish.

*Sidewalks:* There will be sidewalks as shown on the drawings. The sidewalks shall be 4,000-psi strength concrete and shall be reinforced with industrial strength fiber mesh (or as shown) and shall have a broom finished.

Concrete Tests: The Contractor shall have compression tests performed on the concrete placed at his expense and under his direction. At least 4 cylinders shall be made for each 150 cubic yards of concrete placed, or fraction thereof, of each mix design of concrete placed in any one day. Test results shall be furnished to Owner prior to payment for the work.

Refer to section 3001 for additional requirements.

#### *STORM DRAINS*

See drawings for required materials for storm drainage materials.

#### *SEEDING AND RIP-RAP*

Seeding to be done per Section 2260. The Rip-rap to be done as shown on plans.

#### *PART 3 – EXECUTION:*

##### *CONCRETE:*

All concrete shall be placed per ACI requirements. Refer to section 3001.

##### *PROTECTION*

The contractor shall take every precaution to protect the adjacent existing buildings, roadways, utilities, etc. from being damaged during construction. Any damage done shall be repaired promptly by the Contractor at the contractor's expense.

##### *GENERAL*

The Contractor shall perform all work in accordance with recommendations of the geo-tech engineer, drawings and these specifications. The contractor shall cut or

fill the site(s), as applicable, to bring the site to the grades indicated on the drawings. Refer to Erosion Control section for additional requirements. The ground is to be sloped away from the structures, for proper drainage. The site, where applicable, shall be cleaned of all weeds, briars and bushes. Final dressing shall be performed prior to seeding.

If the Contractor encounters the remains of humans, artifacts, anything with historical or archaeological, or other material, which may require examination, the construction shall be stopped and the Engineer notified.

When all work is complete, the site is to be cleaned up and reseeded as applicable. All disturbed areas, except for locations of driveways or where other structures are located, shall be seeded.

See geo-tech requirements above.

The contractor will be responsible for payment of the testing required and observations by a geo-technical representative.

#### *CLEARING AND GRUBBING:*

Prior to construction of any structure, the site is to be cleared. This is to include clearing, grubbing, removal and disposal of all vegetation and debris within the limits of the site. The site shall be stripped of all brush, grass, topsoil, etc. Any depressions created by clearing operations shall be filled and compacted with suitable material. All material removed shall be disposed of by contractor in accordance to local regulations.

#### *EXCAVATION:*

Prior to beginning excavation, grading, and embankment operations in any area, all necessary Clearing and Grubbing, Removal of structures and Obstructions and placement of Erosion control devices in that area shall have been performed in accordance with specifications and applicable regulations.

Excavation materials shall be removed in such a manner that the slopes may be neatly trimmed to grade lines shown on drawings. If more material is required to complete the embankments after all cuts have brought to grade, additional materials must be obtained by the Contractor. Any excess excavated soil and rocks excavated that is not needed for embankment may be disposed of on site in area approved by the Owner. The excess fill shall be placed on an area stripped of top soil and brush and compacted per requirements for embankments. Any excess material removed that is not suitable to be used for fill (including brush, roots, parts of trees, and other perishable material) or that the contractor does not want to compact, shall be removed from the site and

disposed of by contractor in accordance with applicable regulations. When boulder formations occur in the excavation areas, the area shall be scarified and all boulders removed to a depth of twelve inches below grade. The remaining cavities shall be filled with crushed stone or other suitable material and compacted. All loose rock on cut slope shall be removed. Excavation material that remains after all embankments have been completed shall be wasted on site as directed by the Engineer.

Any material that has been excavated, or from clearing and grubbing operations, that is unsuitable to be used in embankments shall be disposed by the Contractor in accordance with applicable regulations. All excavated material that is not needed for backfill can be wasted on-site.

#### *UNDERCUTTING:*

When directed by Engineer or soils testing representative, some unsatisfactory materials below grade may be required to be removed. Undercutting will consist of the removal and disposal of such materials as may be required. Undercutting may also be required for pipe placement or for other structure placement. This does not include stripping, stockpiling and placement of topsoil.

#### *EMBANKMENTS:*

Only approved materials shall be used in embankments and backfills.

If any material is needed for fill, the contractor shall furnish suitable material from on-site. In the event that suitable material is not available on-site, the contractor shall furnish the material from off-site. If any excess or unsuitable material exists, the Contractor shall dispose of said material in appropriate manner at his expense.

The original ground surface, or the surface of any embankment layer, shall not be in frozen state, and shall be free from snow, ice and mud when a subsequent layer is placed thereon.

All depressions or holes below the natural ground surface shall be filled with suitable fill material and compacted to elevation of adjacent ground before embankment construction is started.

Backfilling around a structure shall have been completed and thoroughly compacted to ground surface before any embankment materials are placed thereon.

Any area requiring fill to achieve final grade shall be proof-rolled with pneumatic tire equipment having a static weight of at least 10 tons. The Engineer shall observe the proof-rolling operations. If any areas rut excessively or "pump" the

area shall be undercut to firm soil (or a minimum depth of 3 feet) and replaced with select structural fill and re-compacted.

Unless otherwise specified in the Contract Documents, in any area where the fill is less than three feet the area shall be cleared. In addition, the area shall be completely plowed or scarified to a minimum depth of 6 inches and then re-compacted.

Perishable materials, such as brush, weeds, roots, stumps, tree limbs, etc. shall not be incorporated or buried in the fill. The Contractor in accordance with applicable regulations shall dispose the perishable waste material. The Engineer, prior to being incorporated in the fill, shall approve any non-perishable material that is waste.

Fills shall be constructed so that adequate surface drainage will be provided at all times. Fill materials shall be placed in horizontal layers not to exceed 8 inches in depth prior to compaction.

Each layer of fill shall be compacted to a density of 98% of maximum density.

#### *FOUNDATION PREPARATION AND BACKFILL*

Foundation preparation shall consist of necessary excavating, removal, stockpiling and satisfactory disposal of all material within the limits of the foundation excavation.

When rock or other unyielding material is encountered in the foundation excavation, it shall be removed to a depth of 6 inches below the foundation grade. Excavation shall be brought up to grade with the placement of compacted crushed stone.

All suitable excavated material shall be utilized as backfill material. Backfill material adjacent to underground concrete structures shall consist of stone backfill per geo-tech report and structural drawings, extending from the wall of the structure as shown on drawings.

#### *INSPECTION AND TESTING*

The Contractor shall obtain, at his own expense, all inspections required by law, ordinances, rules, regulations, or public authority having jurisdiction over the work which is part of these specifications. All labor, materials, and equipment necessary for these tests shall be provided by the Contractor. He shall obtain certification of such inspections and submit them to the Engineer. This shall include cost of soil and concrete testing.

Any fill area shall be tested. Any cut area in the vicinity of the structure shall be reviewed and approved by the geo-technical engineer prior to construction of the tank. Maximum density and optimum moisture will be determined by an independent testing laboratory hired by the Contractor in accordance with ASTM D-698 (Standard Proctor). The determination of the density of the soil in place will be in accordance with an approved method. A minimum of 2 tests per layer are required but at least 1 test every 2,500 sf of area. Each layer of fill shall be compacted to required density and approved before material for the next succeeding layer is placed. The moisture content of the fill shall be in accordance with the recommendations of the testing lab.

Following the tests and inspections, the Contractor shall submit, in writing, the specific results.

See concrete section for concrete testing.

Any defects identified by tests or inspections shall immediately be corrected by the Contractor and the tests repeated at the Contractor's expense.

#### *PART 4 - PAYMENT*

All earthwork is part of the lump sum payment for the wastewater treatment plant upgrade.

*END OF SECTION*



# **SECTION 2260**

## **SLOPE PROTECTION, STORM WATER DISCHARGE, AND**

### **EROSION CONTROL**

#### *PART 1 – GENERAL*

#### *REQUIREMENTS OF THIS SECTION:*

It is the intent of this section to require all construction work to be done to meet all local, state and federal requirements related to slope protection, storm water discharge and erosion control. In the event that any requirements listed in this set of contract documents are in conflict with any pollution control law, regulations of the State, Local or Federal Governments, the more restrictive of the laws, rules or regulations shall apply.

#### *DESCRIPTION:*

This Section shall consist of temporary and permanent measures to effectively reduce erosion, sedimentation and prevent water pollution that might result from this project. It also includes any work required by Contractor to meet requirements of Tennessee for Storm Water Discharges from Construction Activities. The work shall consist of measures utilizing berms, dikes, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices in order to meet the State of Tennessee Regulations. The work shall be done following the Tennessee Erosion & Sediment Control Handbook, latest edition, and meet the requirements of the Tennessee Water Quality Control Act of 1977.

The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features, to assure economical effective, and continuous erosion control throughout the construction and post-construction period.

The contractor shall designate an individual, who will be on the construction site to be responsible for erosion and sediment control and storm water pollution prevention. This person shall maintain records of checks and repairs on site or at a nearby office of erosion control devices. This inspector must have successfully completed the "Fundamentals of Erosion Prevention and Sediment Control" course, or an equivalent course. See SWPPP, if applicable, for more information.

Prior to initiation of construction, the contractor shall thoroughly review the project and determine if utility line crossings of streams will be accomplished per requirements of the Aquatic Resource Alteration General Permit For Utility Line Crossings of Streams of the State of Tennessee dated April 7, 2015.

## **STORM WATER DISCHARGES FROM CONSTRUCTION ACTIVITIES:**

In general, a Notice of Intent Form (NOI), to be covered under the State's Storm Water Discharge General Permit, is needed on a construction site when more than 1 acre is being disturbed. In some instances, a permit is needed even when the area is less than 1 acre. The Contractor shall review the State's requirements for this (which is not contained in this document) to determine if a NOI is needed. If so, the Contractor shall contact the Owner to determine if the NOI has been approved.

If a Storm Water Pollution Prevention Plan (SWPPP) and a NOI have been prepared for this project (depending on the design and the amount of area projected to be disturbed) the contractor shall sign the NOI and submit to TDEC for approval prior to initiation of construction. The SWPPP shall be reviewed by the contractor and followed. If the contractor determines it will be necessary to deviate from the SWPPP the contractor shall notify the Engineer. If a change is approved by the Engineer the SWPPP is to be revised prior to implementation.

If a NOI is required, a Notice of Termination (NOT) will also be required. The NOT must be submitted to the State after completion of their construction activities and final stabilization of their portion of the site.

*It is not anticipated that more than 1 Acre will be disturbed for this project so a SWPPP and a NOI were not developed for this project. If more than 1 Acre is disturbed the contractor will be responsible for preparing and obtaining approval for these documents. However, the contractor must install structures necessary to prevent sediment from leaving the site and stabilize disturbed areas as necessary to prevent erosion. The contractor must follow the requirements of the State of Tennessee.*

## **PART 2 – MATERIALS:**

The following are descriptions of some of the erosion control devices that may be used. Illustrations of these are contained in the TENNESSEE EROSION AND SEDIMENT CONTROL HANDBOOK prepared by the Tennessee Department of Environment and Conservation.

### **TEMPORARY BERMS:**

A temporary berm is constructed of compacted soil, with or without a shallow ditch, at the top of fill slopes or transverse to centerline on fills.

These berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.

### *TEMPORARY SLOPE DRAINS:*

A temporary slope drain is a facility consisting of stone gutters, half-round pipe, metal pipe, plastic pipe, sod or other material acceptable to the Engineer that may be used to carry water down slopes to reduce erosion.

### *SEDIMENT STRUCTURES:*

Sediment basins, ponds, and traps, are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the construction areas from excessive siltation.

### *CHECK DAMS:*

Check dams are barriers of logs and poles, large stones or other materials placed across a natural or constructed drainway.

Stone check dams shall not be utilized where the drainage area exceeds fifty (50) acres. Log and pole structures shall not be used where the drainage area exceeds five (5) acres.

### *SEEDING AND MULCHING:*

Temporary or permanent seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting utilized to reduce erosion. All cut and fill slopes including waste sites and borrow pits shall be seeded when and where necessary to eliminate erosion. In addition, all disturbed areas that are not to be paved, concreted, graveled or receive other specified surfaces are to be seeded.

Grass seed shall meet the following mixture requirements depending on when the grass will be sown. No grass is to be sown between December 1 and January 31 except for temporary erosion control or as directed by Engineer.

February 1 – June 1		
Kentucky 31 Fescue	90%	
English Rye	10%	
June 2 – August 15		
Kentucky 31 Fescue	75%	
English Rye	25%	
August 16 – December 1		
Kentucky 31 Fescue	90%	
English Rye	10%	

Lime shall be agricultural limestone with not less than 85% calcium carbonate and magnesium carbonate combined.

Fertilizer shall be 10-10-10, commercial type with 50% of the elements derived from organic sources.

All grass seed shall be delivered to the project site in original containers showing analysis of seed mixture, percentage of pure seed, expiration date, and weight. Fertilizer and lime are to be delivered to project site in waterproof bags showing weight, chemical analysis and manufacturer.

#### *BRUSH BARRIERS:*

Brush barriers shall consist of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operations.

Brush barriers are placed on natural ground at the bottom of fill slopes, where the most likely erodible areas are located to restrain sedimentation particles.

#### *BALED HAY OR STRAW CHECKS:*

Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing five (5) cubic feet or more of material.

Baled hay or straw checks shall be used where the existing ground slopes toward or away from the embankment along the toe of slopes, in ditches, or other areas where siltation erosion or water run-off is a problem.

#### *TEMPORARY SILT FENCES:*

Silt fences are temporary measures utilizing woven wire or other approved material attached to posts with filter cloth composed of burlap, plastic filter fabric, etc., attached to the upstream side of the fence to retain the suspended silt particles in the run-off water.

### *PART 3 – EXECUTION:*

#### *UTILITY LINE CROSSINGS:*

All work on the project shall be done in accordance with the State's Storm Water Discharge General Permit (referenced above) and all other applicable regulations. If the contractor anticipates that for any reason the utility line crossings of streams cannot be done in accordance with the General Permit, the Contractor shall give written notice

to the Engineer and the Owner. In addition, the Contractor shall submit (with notice) the information required for submittal to the State of Tennessee for a individual "Aquatic Resource Alteration Permit". No extension of contract time, nor increase in contract price, will be granted contractor for permit processing or construction costs associated with permit. No work shall be done on the crossing until an individual permit is obtained, if such a permit is required. Contractor is encouraged to complete utility line crossings per general permit requirements if at all possible.

#### *PROJECT REVIEW:*

The Contractor shall review in detail the expected problem areas in regard to the erosion control work. The Contractor shall also review the site to determine if a Storm Water Notice of Intent form is required. Different solutions should be discussed so that the best method might be determined. It is the basic responsibility of the Contractor to develop an erosion control plan acceptable to the State of Tennessee and to meet the State's requirements related to Storm Water Discharge. See Part 1 above for requirements for a SWPPP. The Contractor shall make every effort to prevent any pollution, erosion or sediment from construction activities.

#### *CONSTRUCTION REQUIREMENTS:*

Clearing and grubbing must be held to the minimum necessary for the construction activities required. Construction must be sequenced to minimize the exposure time of cleared surface area. Grading activities must be avoided during periods of highly erosive rainfall. Construction must be staged or phased for large projects. The Engineer has the authority to limit the surface area of erodible earth material exposed. The Engineer can also require the Contractor to provide immediate, permanent, or temporary berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, seeding or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds to the extent directed by the Engineer. Under no conditions shall the surface area of erodible earth material be exposed at one time by clearing and grubbing, exceed 750,000 square feet without approval of the Engineer. Areas of one phase must be stabilized before another phase can be initiated. Stabilization shall be accomplished by temporarily or permanently protecting the disturbed soil surface from rainfall impacts and runoff.

The Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in his accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise erosion control measures may be required between successive construction stages.

Erosion and sediment control measures must be in place and functional before earth disturbing operations begin, and must be properly constructed and maintained throughout the construction period.

Regular maintenance must be a part of the erosion and sediment control system. All control measures shall be checked weekly and after each rainfall. During prolonged rainfall, daily checking is necessary. The temporary erosion control features, installed by the Contractor, shall be properly maintained by the Contractor until they are no longer needed or permanent erosion control methods are installed. All materials used for temporary control shall be removed from the project site before the close-out of the project and disposed of by the Contractor.

In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of work as scheduled, and they are directed to be installed by the Engineer or State, such work shall be performed by the Contractor at his own expense.

Construction debris must be kept from entering the stream channel. Stockpiled soil shall be located far enough from streams or drainage ways so that runoff cannot carry sediment downstream.

A specific individual shall be designated to be responsible for erosion and sediment controls on the project site.

#### *VEGETATIVE CONTROLS:*

A buffer strip of vegetation at least as wide as the stream shall be left along the stream bank whenever possible. On streams less than 15 feet wide, the buffer zone shall extend at least 15 feet wide, the buffer zone shall extend at least 15 feet back from the water's edge.

Vegetative ground cover shall not be destroyed, removed, or disturbed more than 15 calendar days prior to construction. Temporary soil stabilization with the appropriate annual vegetation shall be applied on areas that will remain unfinished for more than 30 calendar days. Permanent soil stabilization with perennial vegetation shall be applied as soon as practicable after final construction.

#### *STRUCTURAL CONTROLS:*

Staked and entrenched straw bales and/or silt fence must be installed along the base of all fills and cuts, on the downhill sides of stockpiled soil, and along stream banks in cleared areas to prevent erosion into streams. Straw bales and/or silt fence may be removed at the beginning of the work day, but must be replaced at the end of the work day, when these devices interfere with the construction work.

All surface water flowing toward the construction area shall be diverted around the construction area to reduce its erosion potential, using dikes, berms, channels, or sediment traps as necessary. Temporary diversion channels must be lined to the expected high water level and protected by non-erodible material to minimize erosion. Clean rock, log, sandbag or straw bale check dams shall be properly constructed to detain runoff and trap sediment.

Sediment basins and traps shall be properly designed according to the size of disturbed or drainage areas. Water must be held in sediment basins until at least as clear as upstream water before it is discharged to surface waters. Water must be discharged through a pipe or lined channel so that the discharge does not cause erosion and sedimentation.

Streams shall not be used as transportation routes for equipment. Crossings must be limited to one point. A stabilized pad of clean and properly sized shot rock must be used at the crossing point. All rock shall be clean, hard rocks containing no sand, dust, or organic materials.

Below are some descriptions of structural controls that may be incorporated into the project. Refer to the Tennessee Erosion & Sediment Control Handbook, latest edition, for additional information and illustrations of these structures.

#### *Temporary Berms:*

A temporary berm shall be constructed of compacted soil, with a minimum width of 24 inches at the top and a minimum height of 12 inches with or without a shallow ditch, constructed at the top of fill slopes or transverse to centerline on fills. Temporary berms shall be graded so as to drain to a compacted outlet at a slope drain. The area adjacent to the temporary berm in the vicinity of the slope drain must be properly graded to enable this inlet to function efficiently and with minimal ponding in this area. All transverse berms required on the downstream side of a slope drain shall extend across the grade to the highest point at approximately a 10-degree angle with a perpendicular to centerline. The top width of these berms may be wider and the side slope flatter on transverse berms to allow equipment to pass over these berms with minimal disruptions. When practical and until final roadway elevations are approached, embankments should be constructed with a gradual slope to one side of the embankment to permit the placement of temporary berms and slope drains on only one side of the embankment.

### *Temporary Slope Drains:*

Temporary slope drains consist of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, flexible rubber, or other materials which can be used as temporary measures to carry water accumulating in the cuts and on the fills down the slopes prior to installation of permanent facilities or growth of adequate ground cover on the slopes.

Fiber matting and plastic sheeting shall not be used on slopes steeper than 4:1 except for short distances of 20 feet or less.

All temporary slope drains shall be adequately anchored to the slope to prevent disruption by the force of the water flowing in the drains. The base for temporary slope drains shall be compacted and concavely formed to channel the water or hold the slope drain in place. The inlet end shall be properly constructed to channel water into the temporary slope drain.

Energy dissipaters, sediment basins, or other approved devices shall be constructed at the outlet end of the slope drains to reduce erosion downstream. An ideal dissipater would be dumped rock or a small sediment basin which would slow the water as well as pick up some sediment. All temporary slope drains shall be removed when no longer necessary and the site restored to match the surroundings.

### *Sediment Structures:*

Sediment structures shall be utilized to control sediment at the foot of embankments where slope drains outlet; at the bottom as well as in the ditch lines atop waste sites; in the ditch lines or borrow pits. Sediment structures may be used in most drainage situations to prevent excessive siltation of pipe structures. All sediment structures shall be at least twice as long as they are wide. When use of temporary sediment structures is to be discontinued, all sediment accumulation shall be removed, and all excavation backfilled and properly compacted. The existing ground shall be restored to its natural or intended condition.

### *Check Dams:*

Check dams shall be utilized to retard stream flow and catch small sediment loads. Materials utilized to construct check dams are varied and should be clearly illustrated or explained in the Contractor's erosion control plan.

All check dams shall be keyed into the sides and bottom of the channel a minimum depth of 2 feet. Typical designs are included in the State's erosion control handbook.



Stone check dams should generally not be utilized where the drainage area exceeds fifty (50) acres. Log and pole structures should generally not be used where the drainage area exceeds five (5) acres.

#### *Seeding and Mulching:*

All disturbed areas that were grassed shall be reseeded as soon as possible following disturbance. In addition, all areas where temporary seeding is required for erosion control shall be seeded as soon as possible.

When performing seeding operations, all underground improvements shall be protected from damage. Also prior to seeding, foreign materials, plants, roots, stones, contaminated subsoil and debris shall be removed from the site. Topsoil shall be applied and soil shall be prepared per seed manufacturer's directions. Seed is to be applied at a rate of 6 pounds per 1,000 sf. Lime is to be applied at a rate of 100 pounds per 1,000 sf and fertilizer is to be applied at a rate of 12 pounds per 1,000 sf. Do not apply grass seed and fertilizer at the same time, in the same machine. Do not sow grass immediately following rain, when ground is too dry, or during windy periods. Roll seeded area with roller not exceeding 112 pounds.

After seeding, protection is to be applied. Where grades exceed 3:1, cover seeded slopes with jute matting. Roll matting down slopes without stretching or pulling. Lay matting smoothly on soil surface, burying top end of each section in narrow 6-inch trenches. Leave 12 inches overlap from top roll over bottom roll. Leave 4-inch overlap over adjacent sections. Staple outside edges and overlaps at 36-inch intervals. All seeded areas with a slope of less than 3:1 shall be mulched with straw. Straw shall be of good quality and evenly spread over area at a rate of 75 pounds per 1,000 sf.

Warranty will begin on seeded areas when all seeded areas are properly established and otherwise accepted.

#### *Brush Barriers:*

Brush barriers shall consist of brush, tree trimmings, shrubs, plants and other approved materials. These may come from clearing and grubbing operations. The brush barriers shall be constructed approximately parallel to original ground contours. The brush barrier shall be compressed to an approximate height of 3 to 5 feet and approximated width of 5 to 10 feet. The embankment shall not be supported by the construction of brush barriers.

#### *Baled Hay or Straw Erosion Checks:*

Hay or straw erosion checks shall be embedded in the ground approximately 4 to 6 inches to prevent water from flowing under them. The bales shall also be anchored

securely to the ground by wooden stakes driven through the bales into the ground. Bales can remain in place until they rot, or be removed after they have served their purpose, as determined by the Engineer. The Contractor shall keep the checks in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris cleanout will be considered routine maintenance.

#### *Temporary Silt Fences:*

Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem. Silt fences are constructed of wire mesh fence with a covering of burlap or some other suitable material on the upper grade side of the fence and anchored into the soil.

The contractor shall be required to maintain the silt fence in a satisfactory condition for the duration of the project or until its removal is requested by the Engineer. The silt accumulation at the fence may be left in place and seeded, removed, etc., as directed by the Engineer. The silt fence becomes the property of the Contractor whenever the fence is removed.

#### *EROSION CONTROL OUTSIDE PROJECT AREA:*

Temporary erosion control shall include construction work outside the project area where such work is necessary as a result of this project, such as borrow pit operations, haul roads, equipment storage sites, etc.

#### *PART 4 - PAYMENT*

All erosion control work is part of the lump sum payment for the wastewater treatment plant upgrade and will not be considered for direct payment.

*END OF SECTION 2260*

## **SECTION 02600 – WATER MAINS**

### ***PART 1 - GENERAL***

#### ***SCOPE:***

The work to be done under this Division shall consist of furnishing all labor, equipment and materials to complete all excavation, embankment and preparation of the sites as shown or noted on the drawings or specified herein or both as follows:

- A. Protection against damage to all public and private roads, fences, utilities, etc.
- B. Protect all adjoining property from damage that might be done under this contract.
- C. Installation of water pipe, valves, hydrants, and appurtenances.
- D. Restoration of ground surfaces and properties disturbed.

### ***PART 2 - PRODUCTS***

#### ***MANUFACTURERS:***

Manufacturer's Qualifications: Firms regularly engaged in manufacture of potable water systems, products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. All materials shall be AWWA approved.

#### ***WATER MAINS:***

Type of pipe shall be as indicated on the drawings. The lines 6" or larger are to be ductile iron and the lines 4" or 2" are to be SDR 21 PVC and lines less than 2" are to be copper.

Class 200 (SDR 21) :

PVC pipe shall meet the following ASTM Standards: D-1784 (PVC Compound), D-2241 (PVC Pipe), D-3139 (Joint) and F-477 (Gasket).

Requirements for unplasticized polyvinyl chloride (PVC) pipe with integral thickened wall bell for water supply and distribution systems.

The pipe shall be rated for use in 23°C (73°F) at the maximum internal pressures as follows: SDR 21 (200 PSI). The "extra deep" thickened bell conforms to ASTM D-3139 and is designed to use a dual sealing (hydraulic and compression) rubber ring gasket, seated in a two step race to prevent push out. The design allows for greater contraction and expansion.

The product shall bear the National Sanitation Foundation seal for potable water pipe and be marked in accordance with ASTM D-1784 standard.

The pipe shall be extruded with only Type I, Grade I, 2000 PSI design stress compound meeting ASTM D-1784 standard. The pipe shall be designed to pass, without failure, the burst test for rated class as follows: SDR 21 (630 PSI) when conducted in accordance with ASTM D-1599.

The pipe shall be designed to pass, without failure, the sustained pressure test for 1000 hours for SDR 21 (420 PSI) when conducted in accordance with ASTM D-1598. A two inch long sample ring shall not flake or disintegrate when immersed for 20 minutes in a sealed container of acetone when conducted in accordance with ASTM D-2152. (Swelling or softening is not considered a failure).

A two inch long sample ring shall be compressed between parallel plates to 40% of the outer diameter of the pipe without evidence of splitting, cracking or breaking.

The pipe shall meet the ASTM D-2241 impact resistance when tested in accordance with specification requirements section of method ASTM D-2444.

All pipe shall be furnished in 20' or 40' laying lengths. Forty-foot length will be permitted provided the pipe be transported from the storage area to the laying area on racks specially designed to prevent the ends of the pipe from dragging and that the pipe be handled at all times by a minimum of two workers when being loaded, unloaded, and installed. The contractor shall take all precautions necessary to prevent the pipe from being damaged and shall suspend use of 40 foot sections of pipe should the Engineer so direct.

#### *Ductile Iron Pipe:*

Ductile iron pipe, where used, shall meet the requirements of AWWA C150, latest revision.

The pipe shall be Class 350 for sizes through 12" and Class 250 for 14" through 20". Pipe and fittings shall have cement mortar lining and bituminous outside coating in accordance with AWWA C104, AWWA C151 and AWWA C110. The joints for straight runs shall be push on.

Fittings shall be mechanical joint fittings with body thickness and radius of curvature conforming to AWWA C110-87 rubber gasket joints shall be in accordance with AWWA C111-85. AWWA C153 compact fittings will be acceptable.

*Copper:*

Copper to be Type K.

*Marking Tape and Detection Wire:*

Water pipe metallic detection tape with the word "Water" printed continuously along the tape shall be wrapped around all non-ferrous pipe, approximately every 2 feet and shall run the entire length of the pipe. Also, a #12 coated copper wire shall be installed near the top of the trench for detection.

*VALVES:*

Unless otherwise specified, valves shall be designed to operate continuously under a working pressure of not less than 200 pounds per square inch. Valves suitable for other working pressures shall be furnished as indicated on the drawings. All valves shall be mechanically jointed unless otherwise specified.

All gate valves 2" and larger shall conform to AWWA C500-86. All valves of the above sizes, unless otherwise stipulated, shall be iron body, resilient seat, non-rising stem type. They shall be M&H, or equal. Gate valves smaller than 2" shall be all bronze, wheel handles, screwed gate valves, suitable for the service required.

All butterfly valves 10" and larger shall conform to AWWA C504-80. Valve body shall be cast iron with stainless steel body seat. Vane shall be cast iron with a mechanically secured rubber seat. Valve operator shall be traveling-nut type for underground service.

The air relief valves shall be the same or equal to the Crispin pressure relief valve as manufactured by the Multiplex Manufacturing Company (or equal) with 3/4" inlet connection and a working pressure range of 0-200 psi. A 3/4" bronze double gate valve brass pipe and fittings shall be used on the installation. The installation shall be as shown on the standard drawing.

At the end of each dead end line or at other locations as directed by the Engineer, shall be installed a blow-off valve. The gate valve shall be the same as specified above. Installation shall be as shown in the Standard Details.

All valves shall be tested in the shop at no cost to the owner under a test pressure equal to twice the working pressure and upon request the owner shall be furnished with a certificate stating that all valves have successfully passed such a test.

All valves and fittings used in pressure reducer stations shall have 250 lb. ASA high pressure flanges and shall be as specified on the Drawings.

Cast iron tapping sleeves and valves shall be used to make "wet" taps to existing water mains where indicated on drawings. They shall be "split type" with mechanical joints, and flanged outlet for connection to tapping valve. Contractor shall verify size and type of existing water main prior to purchase of sleeve. The tapping valves shall be M&H AWWA Resilient, rated 200 psi, have non-rising stem, or equal.

#### *YARD HYDRANTS:*

Yard hydrants shall be Eclipse #1, no lead, non-freezing design, as shown on drawing.

#### *FIRE HYDRANTS:*

Fire hydrants shall be of the Dry-Barrel, post type with a pentagon nut. The hydrant shall conform to AWWA C502-85. The hydrant shall have two (2) 2 ½" hose nozzles with National Standard threads and one (1) 4 ½" pumper nozzle with National Standard threads. The hydrants shall be painted red. Hydrants shall be "break-away" type. Installation details are as designated on the Standard Drawings.

### *PART 3 - EXECUTION*

#### *GENERAL:*

Under this section is included the inspection, laying, jointing, and testing of all water pipe, including water appurtenances, both in open cut and in tunnels, as shown on the drawings or as directed by the Engineer.

#### *HANDLING OF MATERIALS:*

Care shall be exercised in loading and unloading pipe to prevent damage to the pipe. The degree of care in handling the pipe and accessories shall meet the recommendations of the pipe manufacturer.

Proper implements, tools, and facilities shall be provided to allow safe and convenient execution of the work. Under no circumstances shall pipe or accessories be dropped into the trench.

Care shall be exercised to keep pipe clear of mud, dirt, and debris before and during laying.

No pipe shall be laid in water, and precautions shall be taken to prevent trench water from entering the pipe.

All pipe, per manufacturer's directions, shall be stored to prevent damage. PVC pipe shall be covered to protect from sunlight.

All pipe shall be inspected just prior to laying. If any portion of a shipment is found to be defective in diameter or thickness, the entire shipment shall be removed from the project at the Contractor's expense.

Ductile iron pipe shall, prior to laying, be visually inspected for defects and rung with a light hammer to detect cracks. Any defective pipe will be rejected.

All rejected pipe shall be removed from the project immediately and replaced at the expense of the Contractor.

#### *WATER TRENCH EXCAVATION:*

The contractor shall excavate for pipe installation to the minimum depths shown on drawings. In addition, in all areas the line and service lines shall be installed a minimum of 36" below the elevation of all roads. Where 36" of cover cannot be obtained and approved by the Engineer, the line may be encased in concrete. Unless otherwise shown, the main line is to be installed adjacent to the road. The contractor shall make every effort to install the waterline 3 feet from the shoulder where possible. There are some roads, or portions of roads, where this will not be possible. Any areas where this requirement cannot be met, the contractor shall backfill with gravel. This gravel that is required when the line is within 3 feet of the road is not a pay item and is considered incidental. The excavation shall include all material encountered. The Contractor shall, at all times during construction, provide and maintain necessary equipment for the removal of all water which enters the excavation. Trenches shall be kept firm and dry at all times. No direct payment will be considered for this work.

Excavated materials which are surplus or unsuitable for back filling shall be removed from the site of operations as soon as excavated. All excess or unsuitable excavated materials shall be disposed of at locations obtained by the Contractor. The Contractor shall secure written permission from the property owner(s) and furnish the Engineer with a copy of the agreement(s).

Excavated materials to be used for backfill shall be stored in neat piles adjacent to the excavation. Piles should be placed so that they will not interfere with traffic, be safety problems, or interfere with construction activities.

Open-cut excavation, either in earth or rock, shall be safely supported and of width and depth shown on drawings. Trenches shall not remain open overnight or at any time the Contractor is not on the job site.

The required width and sub-grade of the trench will vary according to the size of the water pipe to be installed, as shown on the drawings. If the maximum allowable trench width 12" above the top of the water pipe is exceeded, a higher strength classification of water pipe of sufficient strength for that particular trench width will be required, at no additional cost to the Owner. Unauthorized excavation below sub-grade shall be filled with crushed stone or concrete as ordered and directed by the Engineer at no additional cost to the Owner.

When the bottom of the excavation is unsuitable as a foundation, it shall be excavated below sub-grade and then refilled with concrete or compacted crushed stone to the sub-grade as the Engineer may direct. Such authorized work shall be paid for as set forth under the appropriate item of the Bid.

When rock is encountered in open cut excavation, it shall be removed by method selected by Contractor. The trench dimensions shall conform with the lines, grades and dimensions shown on the drawings. The Contractor shall notify the Engineer prior to removal of any rock.

When blasting is required, for the removal of rock, every precaution shall be taken to protect persons and property. Each blast shall be covered with mats to confine the rock fragments within the excavation. Only the minimum amounts of explosives shall be used; no excessive charges will be permitted. Blasting shall be performed at a safe distance ahead of the installation of the water pipe and structures to prevent damage to them as the work progresses. Blasting of rock for property service connections, T-branches, Y-branches, and studs shall be performed at the same time as the water pipe trench blasting. The rock shall be shattered by continuing the drilling and blasting operations 6 feet beyond the end of the water pipe, branch, stub or property service connection. Except with written permission and approval of the Engineer, no blasting of rock will be permitted at nights or on Sundays. See section 1000 for additional requirements. All excavated rock permitted to be used for backfilling purposes shall be used in accordance with these Specifications. All rock that is unsuitable for backfill shall promptly be removed from the site of the work at no additional cost the Owner.

#### *SHEETING & BRACING:*

The Contractor shall furnish, place and maintain adequate sheeting and bracing as may be required to support the sides of the excavation. Sheeting and bracing may be used to prevent any movement of earth which could diminish the width of the excavation or cause damage to adjacent properties. If, in the opinion of the Contractor, Sheeting and Bracing is needed the Contractor shall discuss this with Engineer. Sheeting may be of wood or steel and shall be of adequate strength for the excavation. Wherever possible, the sheeting and bracing shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If it is necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along where the sheeting will be driven. Care shall be taken to prevent voids outside the sheeting; but, if voids develop, they shall be immediately filled with selected sandy materials and compacted as directed by the Engineer. The Engineer may order sheeting and bracing to be left in place at locations. Sheeting left in place may be ordered to be cut off at any specified elevation, but in no case shall it be left in the ground above an elevation 18 inches below the existing or proposed surface of the ground. All voids created by the cutting off of the sheeting to be left in place shall be immediately filled with selected sandy materials and compacted as directed by the Engineer.

Sheeting and bracing left in place in open cut trenches as shown on the drawings or as ordered by the Engineer shall be paid for under the appropriate items of the Bid. If the



Contractor elects not to remove certain sheeting and bracing, he will not be paid additionally for such sheeting and bracing left in place. Any sheeting left in place at the Contractor's option must be approved by the Engineer. All sheeting and bracing not to be left in place shall be carefully removed (after the backfill is complete) so as to not endanger the water pipe and other structures. All voids created by withdrawal of the sheeting shall be immediately filled with selected sandy materials and compacted as directed by the Engineer.

#### *OPEN-CUT PIPE LAYING:*

All pipe that is to be installed by open-cut method, shall be laid to the required grade and alignment. Any deviations from the alignment and grade shown on the drawings shall be as directed by the Engineer. Minimum cover over mains shall be 30 inches unless otherwise indicated on drawings or under pavement, which shall have 36 inches minimum cover. Indentions shall be made at the bell and/or coupling locations to prevent load concentration on the bell and/or couplings.

Fittings and valves shall be located at the plan location with all joints centered, spigots home, and valve stems plumb.

All joints shall be watertight and any leaks or defects discovered shall be immediately repaired to the satisfaction of the Engineer. Any pipe which has been disturbed after being laid shall be removed, the joints cleaned, and the pipe properly re-laid. Damaged or unsound pipe or fittings will be rejected. Before jointing the pipe, all lumps, blisters, excess coating material, and any dirt or sand shall be removed from the ends of pipes. Any superfluous material inside the pipe shall be removed by means of an approved follower or scraper after joints are made.

Factory-made joint materials shall be utilized. Installation shall be accomplished in strict accordance with the manufacturer's recommendations and with approval from the Engineer.

When lowered into the trench, the spigot, bell and gasket shall be cleaned in accordance with the manufacturer's recommendations. The pipe shall be pushed home and the gasket pressed firmly and evenly around the entire socket. The gland then pushed up to the bell and centered on the spigot of the pipe. Glands for large diameter pipe may require a wedge under the top side to assist in centering the gland lip against the gasket.

The bolts are then inserted and tightened with the fingers until all are even. The bolts shall then be tightened as recommended by the manufacturer.

In no case shall water be allowed to rise in or above the pipe before the joint has become thoroughly set. No walking on or working over the pipe after they have been laid, except as may be necessary in placing and compacting the backfill, will be permitted until they are covered with backfill to a depth of 24 inches.

### *CUTTING PIPE:*

Cutting of pipe for the insertion of valve fittings shall be done in a manner recommended by the manufacturer so as to avoid damage to the pipe or coating.

### *PERMISSIBLE DEFLECTION AT JOINTS:*

The degree of deflection of a pipe in either the horizontal or vertical planes shall be as directed by the Engineer, but shall in no case exceed the recommendations of the manufacturer.

### *DITCH, STREAM, HIGHWAY & RAILROAD CROSSINGS:*

Pipes crossing under ditches and streams shall be as shown on the drawings with bends not exceeding the angles shown.

### *CRADLE AND ENCASEMENT:*

If, in the opinion of the Engineer, pipe cradle or encasement is needed the Contractor shall install as directed. Where the water pipe is to be laid in a crushed stone cradle, the crushed stone shall meet requirements for Class "B" aggregate, Grading "D" as defined by current Tennessee Department of Transportation Standard Specifications For Road and Bridge Construction. The crushed stone shall be deposited in the excavated trench to grade, allowing for the water pipe wall thickness and joints.

If concrete encasement is required, in the opinion of the Engineer, the concrete shall be 3,500 PSI. The depth and length of the encasement shall be as directed by Engineer. Proper bracing of the pipe shall be provided to prevent its being floated by the concrete encasement.

### *SEPARATION OF WATER MAINS AND SEWERS:*

Water lines and sewer mains shall be separated per State of Tennessee requirements. They shall not be placed in the same trenches in any instance.

Whenever possible, water mains should be laid at least 10 feet horizontally from any existing or proposed sewer lines. Should local conditions prevent a lateral separation of 10 feet, they may be laid closer than 10 feet if the water line is laid in a separate trench, and if the elevation of the top (crown) of the sewer is at least 18 inches below the bottom (invert) of the water main.

Whenever water mains must cross over sewer lines, the water lines shall be laid at such elevation that the top of the sewer is at least 18 inches below the bottom of the water main. If this requirement cannot be met, the sewer main shall be relocated to provide this separation.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and sewer shall be constructed of mechanical-joint cast-iron pipe and shall be pressure-tested to assure water tightness. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

No water pipe shall pass through or come into contact with any part of a sewer or sewer manhole.

#### *THRUST BLOCKS:*

All valves, blowoffs, all plugs capped, all reducers, all bends, and other fittings shall be securely anchored by thrust blocking as shown on the drawings. GripRings (Romac Industries, Inc., or equal) shall be used on all pipes 4" and larger, at all blowoffs, valves, where pipe changes from PVC to DI, at reducers, bends and other fittings. Thrust blocks are also required at these locations.

#### *WATER PIPE BACKFILL:*

Backfilling of excavated trenches in open cut shall be completed as soon as possible after the water line is laid and reviewed by owner's representative. Any pipe not reviewed prior to backfill will not be considered for payment.

The following materials shall be used to backfill the trenches:

1. *Stone:* Backfill in trenches within the limits of existing or proposed paved surfaces or shoulders, where defined in the drawings or authorized by the Engineer, shall be made with crushed stone, crushed slag or washed gravel meeting the requirements of Subsection 903.17 of the Tennessee Department of Transportation Standard Specifications. The backfill shall extend from the top of the bedding to the bottom of the existing or proposed paving base. Stone backfill will also be required where the line is installed closer than 3 feet to the road. See Water Trench Excavation section.
2. *Selected Excavated Materials:* Backfill in trenches for water lines shall be made with selected excavated materials taken from the trench excavation except where stone backfill is required or the excavated materials are not suitable. The selected excavated materials used from the top of the pipe to 2 feet above the top of the pipe shall contain no rocks. The selected excavated backfill materials used between the plane 2 feet above the top of the pipe or structure and one foot below the ground surface may include rock fragments taken from the excavation. In backfill containing rock, the maximum dimension along any axis of rock shall not exceed six inches, and all rock fragments shall be mixed with sufficient earth materials to completely eliminate all voids, subject to the approval of the Engineer. The amount of rock in the backfill shall not exceed 33% of the total backfill. Rock fragments and surplus earth materials not used in the backfill shall be removed from the site of the work at no expense to the Owner.

Backfill material shall be compacted as recommended by pipe manufacturer, indicated on the drawings or allowed by the Engineer.

If materials for any method of backfilling is dumped, bulldozed, or dropped from a height exceeding 5 feet above the previously placed backfill, its fall shall be broken by timber grillage or other means acceptable to the Engineer to prevent possible damage to the water lines.

Suitable backfill materials required, in addition to that which is excavated from trenches, shall be purchased by the Contractor, at no additional cost to the Owner.

#### *LEAKAGE TESTS:*

The Contractor shall test all sections of water lines in accordance with the Tennessee Department of Health & Environment Regulations and these specifications. All labor, materials and equipment used in testing procedures (including water) shall be furnished by the Contractor.

*Hydrostatic Tests:* After water pipe has been laid and backfilled, all newly laid pipe or any valve section thereof shall be subject to a hydrostatic pressure of not less than 200 psi or 1 ½ times anticipated line pressure, whichever is greater. The duration of the pressure tests shall be two hours. Each valve section of pipe shall be slowly filled with water. While the pipe is being filled and before the application of the specified test pressure, all air shall be expelled from the pipe. Taps (other than what is required by drawings) may be required at points of highest elevation. These taps are to be tightly plugged after completion of the test and will not be considered for payment. The test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pump connections, gauges, and all necessary apparatus and labor shall be furnished by the Contractor. The Contractor shall calibrate the gauges in the presence of the Engineer.

A test shall be made only after a part or all of the backfilling has been completed and at least 36 hours after the last concrete thrust block has been cast with high-early-strength cement or at least seven (7) days after the last thrust block has been cast using standard cement.

Any cracked or defective pipes, fittings, or valves discovered during hydrostatic pressure tests shall be removed and replaced with sound material and the test repeated until satisfactory to the Engineer. No payment shall be made for the removal and replacement of defective pipes and appurtenances.

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure. Leakage shall not be measured by a drop in pressure in a test section over a period of time. See Table 1 below:

Table 1.  
Allowable leakage per 1000 ft of pipeline\* - gph†

Avg. Test Pressure psi	NOMINAL PIPE DIAMETER—in.																	
	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60	64
450	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97	5.52	5.88
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53	5.04	5.37
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05	4.50	4.80

\*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

†Calculated on the basis of Eq.1.

Allowable leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

In inch-pound units,

$$L = \frac{SD \square P}{133,200}$$

Where:

L	=	allowable leakage, in gallons per hour
S	=	length of pipe tested, in feet
D	=	nominal diameter of the pipe, in inches
P	=	average test pressure during the leakage test, in pounds per square inch (gauge)

#### *DISINFECTION OF PRESSURE WATER PIPELINES:*

Before being placed into general use all pressure water piping and pipelines shall be flushed thoroughly, disinfected with chlorine and flushed again, per AWWA C651 and the State of Tennessee Regulations. Refer to section 02516.

Blow-offs may be required for flushing. Those required but not shown on drawings will not be considered for direct payment but will be considered incidental. These flushing points may be left in place after testing only if approved by Engineer. Sampling ports are also required and will not be considered for direct payment.

The Contractor shall repeat the disinfection procedure until samples indicate proper bacteriological quality and the approval of the Tennessee Department of Environment & Conservation is given.

All expenses for testing, disinfecting and flushing prior to approval and acceptance of the work shall be borne by the Contractor. Cost of water for testing, disinfecting and flushing will be paid by Contractor. The water department's representative will take the bacteriological samples. However, the contractor will be responsible for the cost of having tests run.

#### *SETTING VALVES, VALVE BOXES & FITTINGS:*

All gate valves, and any other valves designated, shall be set in cast iron Buffalo type, two-piece screw type valve boxes unless otherwise indicated on the plans. Wrench nuts shall be readily accessible through the opening. Valve boxes shall be firmly supported and shall be kept centered and plumb over the wrench nut of the gate valve. The box cover shall be flush with the surface of the finished pavement or any other level designated by the Engineer.

Drainage branches or blow-offs shall not be connected with any sewer or submerged in any stream or be installed in any other manner which will permit back siphonage into the distribution system. A steel valve marker post and sign shall be erected at the location of each valve. Concrete pads shall be placed around each valve box.

*PLUGGING DEAD ENDS:*

Standard plugs shall be inserted into the bells of all dead end fittings. Spigot ends shall be capped. Thrust blocking shall be provided at all dead ends of pipe that are capped or plugged.

*UTILITIES RELOCATION AND REPAIR:*

Contractor shall relocate or repair any utility lines damaged during construction. No separate payment will be made for repair or replacement.

All repair materials shall be equal to type of pipeline damaged and repaired to the satisfaction of the utility owner.

All repair materials shall be approved by Tennessee Department of Environment & Conservation or other regulatory agency. Contractor shall submit shop drawings on anticipated repair materials unless the materials are provided by the utility owner.

*PAYMENT:*

No separate payment will be made for waterline installation but it is a part of the lump sum bid for project.

*END OF SECTION 2600*

## **SECTION 2700 – GRAVITY SEWER LINES**

### *PART 1 – GENERAL*

#### *SCOPE:*

The work to be done under this Section shall consist of furnishing all labor, equipment and materials to complete excavation, backfill, installation, and testing of gravity sewer lines. Work shall be as shown on drawings or specified in these documents. The work includes:

- A. Installation of gravity sewer lines, manholes, pre-cast boxes and related appurtenances
- B. Protection and restoration of adjoining properties, utilities, etc.

### *PART 2 – PRODUCTS*

#### *GENERAL:*

#### *MANUFACTURERS:*

Manufacturers regularly engaged in manufacture of wastewater products shall furnish products. The products shall be of type, size and quality as those specified. The products shall have been used in similar applications on previous jobs for not less than five years. References on products shall be furnished upon request. See Section 1000 for additional requirements.

#### *INSPECTION OF MATERIALS:*

All pipe, manholes, and other materials used on the projects shall be examined prior to installation. Ductile iron pipe shall be rung with a light hammer to detect cracks. If any portion of a shipment is found to be defective, the entire shipment shall be removed from the project at the Contractor's expense. Useable portions of the rejected materials may be salvaged upon approval of the Engineer. Minimum manufacturer's standard shall be met on all salvaged material.

All pipe, per manufacturer's directions, shall be stored to prevent damage. PVC pipe shall be covered to protect from sunlight.



## GRAVITY SEWER MAINS:

### PIPE

Ductile Iron is to be used for all lines unless otherwise noted.

#### *Ductile Iron Pipe*

Ductile Iron Pipe shall conform to AWWA C151 and ANSI/ASTM A746, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown and shall be furnished complete with rubber gaskets. The ductile iron pipe, specials, and fittings shall be manufactured or supplied by American Ductile Iron Pipe (a division of American Cast Iron Pipe Company, Birmingham, Alabama) or equal.

Ductile iron pipe shall conform to AWWA C151. All pipes shall have a minimum pressure rating of 350 psi for 12" diameter and smaller, 250 psi for diameters of 14" to 20" and 200 psi for diameters 24" and larger.

Ductile Iron Pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, flanged joints, and grooved joints as required.

Unless otherwise specified, buried gravity pipe shall have Push-on joints which shall conform to AWWA C111. Unless otherwise specified gasket material shall be standard styrene butadiene copolymer (SBR.) Push-on joints shall be Fastite, as manufactured by American Ductile Iron Pipe, or equal. The pressure rating for push-on joints shall be a minimum of 350 psi or the specified pressure rating of the pipe, whichever is less. Standard allowable joint deflection for 4" – 30" Fastite pipe shall be five degrees, for 36" Fastite pipe shall be four degrees, and for 42" – 64" Fastite pipe shall be three degrees. Allowable deflection of American's Fastite joint "Special Deflection Bells" for 36" – 42" shall be five degrees and for 48" – 64" shall be four degrees.

For bores longer than 40 feet (or where otherwise specified) joints shall be restrained joints. Restrained joints shall be "Flex-Ring" or "Lok-Ring" restrained joints as manufactured by American Ductile Iron Pipe or equal. Field-adaptable restraint shall be provided through the use of "Fast-Grip" or "Field Flex-Ring" as manufactured by American Ductile Iron Pipe, or other approved and bolt-less, push-on restrained devices. When restrained joints require factory welding, the MANUFACTURER shall qualify all welding procedures and welders used to produce the product per the requirements of a documented quality assurance system based on ANSI/AWS D11.2. Unless

otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR.) Restrained joints and restrained joint pipe shall be rated for specified pressure rating of the pipe. The MANUFACTURER shall furnish test results showing that restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure. Tests shall be performed on pipe with nominal metal thickness less than or equal to that specified for the project. Torque-activated restrained joint devices that rely on threaded bolts or setscrews for joint restraint shall not be used.

Except otherwise provided herein, interior surfaces of all ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with a standard thickness cement-mortar lining applied in conformity with AWWA C104, Portland cement mortar. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be repaired or replaced with lining conforming to these Specifications.

The minimum lining thickness shall be 1/16" for 12" diameter and smaller, 3/32" for 14" to 24" diameters, and 1/8" for 30" diameters and larger.

Ductile iron pipe, specials, and fittings shall be lined with cement-mortar lining with an asphaltic seal coating, 1 mil, in accordance with AWWA C104.

The exterior of buried ductile iron pipe, special, and fittings shall be coated with a 1-mil asphaltic coating in accordance with AWWA C151, Section 51-9. When specified, loose polyethylene encasement shall be supplied in accordance with AWWA C105.

#### *PVC Pipe*

Polyvinyl Chloride (PVC) Gravity Sewer Pipe shall conform to ASTM Standards D-3034 and F-679 and have SDR of 35.

The pipe shall be joined with an integral bell rubber gasket allowing for contracting and expansion at each joint. Joint tightness shall be tested in accordance with ASTM D-3212. The gasket shall be secured in the race by means of a non-metallic polypropylene retainer ring.

The pipe shall be white in color and be furnished in 12.5 feet laying lengths.

#### *AIR PIPING:*

Air Piping shall be ductile iron as specified above except it must not have cement-mortar lining. In addition, all exposed piping shall be flanged joints.

## MANHOLES:

Manholes shall be pre-cast concrete meeting ASTM 478. All sections are to be constructed of 4,000 psi reinforced concrete except flat tops and transition tops which shall be 5,000 psi concrete. Steel reinforcement shall conform to ASTM C-478 Specifications. Lift holes shall be provided in all sections but shall not penetrate through walls. Inverts shall be precast unless otherwise approved. All inverts shall be smooth and changes in sizes, directions, and grades shall be made gradually and evenly. Gaskets are to be provided between sections and all joints shall be mortared. A-lok boots, or approved equal, shall be furnished for all pipe to manhole connections.

All manhole components shall be free of cracks, defects, honeycomb, spalling, etc. Any defective manholes, in the opinion of the Engineer, shall not be used and are to be removed from the project site.

Depth of manhole will be measured from the invert elevations to the top of the lid.

Manhole steps shall be polymer coated ductile iron or steel rod. They shall be placed 16" apart and shall be in a straight line in the completed manhole.

Outside walls of manholes shall be coated with a layer of bitumastic, 10 mil dry thickness. Backfill shall not be placed against manhole until the coating is dry.

*Where specified on drawings, manholes* shall have hydrogen sulfide protection and shall be coated with a XYPEX coating, or equal. This product shall be used to coat the interior walls of manholes. The dry powder shall be mixed per manufacturers recommendations and applied in two coats per manufacturer's instructions.

Manhole frames (except where water tight lids are specified) shall be JR Hoe and Sons MC-375, or equal. They shall be solid and lettered "Sewer". All frames shall have anchor lugs or be anchored to manholes as detailed on the drawings. Watertight lids shall be JR Hoe and Sons MC-375, or equal (where specified).

Manhole adjusting rings shall be installed where existing manholes need to be raised to extend above finished grade. After locating the manhole, the contractor shall determine the size of riser needed to bring the manhole cover to the finished grade surface.

Other pre-cast structures shall also meet these specifications, as applicable.

## *PART 3 – EXECUTION*

### *GENERAL:*

Included under this section are laying, jointing, and backfill of gravity sewer pipe (both in open cut and encased applications) as shown on drawings or as directed by the Engineer.

### *DISRUPTION OF SERVICE:*

It should be noted that there is flow in the existing lines. No sewer shall be allowed to be discharged onto the ground. If any spills are incurred, clean up, fines, etc. are the responsibility of the contractor. Refer to section 1000.

### *SEWER TRENCH EXCAVATION*

The Contractor shall excavate for pipe installation to depths as shown on drawings. This shall include all material encountered. The Contractor shall, at all times during construction, provide and maintain necessary equipment for the removal of all water that enters the excavation. Trenches shall be kept firm and dry at all times. No direct payment will be considered for this work.

Excavated materials that are surplus or unsuitable for backfilling shall be removed from the site as soon as excavated. All excess or unsuitable excavated materials shall be disposed of at locations obtained by the Contractor. The Contractor shall secure written permission from the property owner(s) and furnish the Engineer with a copy of the agreement(s).

Excavated materials to be used for backfill shall be stored in neat piles adjacent to the excavation. Piles should be placed so that they will not interfere with traffic, be safety problems, or interfere with construction activities.

Open-cut excavation, either in earth or rock, shall be safely supported and of width and depth shown on drawings. Trenches shall not remain open overnight or at any time the Contractor is not on the job site.

Excavations for sewer pipe in both earth and rock shall have a minimum and maximum allowable trench width below the outside top of the sewer pipe as shown on the Drawings. The trench shall be excavated to a specified depth below the outside diameter of the pipe, hereafter called the sub-grade, so as to permit the placing of the sewer and appurtenances at the specified elevations on the bedding or encasement material. Depth of pipe (for payment purposes) shall be measured from the bottom of pipe to top of ground.

The required width of the trench will vary according to the size of the sewer pipe to be installed. If the maximum allowable trench width 12" above the top of the sewer pipe is exceeded, a higher strength sewer pipe (to be approved by Engineer for particular application) will be required, at no additional cost to the Owner.

The required depth of sub-grade below the outside diameter of the sewer pipe will be 6" in rock and 4" in earth.

When the bottom of the excavation is unsuitable as a foundation, in the opinion of the Engineer, the Engineer may direct the trench to be excavated below sub-grade and then refilled with concrete or crushed stone to the sub-grade. Such work must be authorized by Engineer prior to implementation and will be paid for as set forth under the appropriate item of the Bid. When sub-grade becomes unsuitable due to uncontrolled water (when pumping rate is insufficient) additional pay for use of crushed stone will not be considered.

Unauthorized excavation below sub-grade shall be filled with crushed stone or concrete as ordered and directed by the Engineer at no additional cost to the Owner.

Rock excavation is defined as rock which cannot be economically excavated without the use of explosives or is a boulder or formation having a volume of greater than one-half (1/2) cubic yard.

When rock is encountered in open cut excavation, it shall be removed by drilling, blasting, digging or other approved methods so that the open cut trenches conform to the lines, grades and dimensions shown on the Drawings. The Contractor shall notify the Engineer prior to removal of any rock.

When blasting is required for the removal of rock, every precaution shall be used for the protection of persons and private and public property. Each blast shall be well covered with mats or other suitable means to confine the rock fragments within the excavation. Only the minimum amounts of explosives shall be used; no excessive charges will be permitted. Blasting of rock for property service connections, T-branches, Y-branches, and stubs shall be performed at the same time as the sewer trench blasting. The rock connections, shall be shattered by continuing the drilling and blasting operations 6 feet beyond the end of the sewer, branch, stub or property service connection. Except with written permission and approval of the Engineer, no blasting of rock will be permitted at nights or on Sundays. Contractor is required to have pre-blast surveys done of structures near blasting sites.

If, for any reason, rock is excavated beyond the necessary limits as shown on the Drawings, such unauthorized excavation, or over breakage, shall be

refilled with crushed stone or concrete as directed by the Engineer, at no additional cost to the Owner.

All excavated rock permitted to be used for backfilling purposes shall be used in accordance with these specifications. All rock specified as unsuitable for backfill shall be removed from the site of the work at no additional cost to the Owner.

## *OPEN CUT PIPE INSTALLATION*

### *GENERAL*

All installation work shall be done per manufacturer's recommendations.

Proper implements, tools and equipment shall be provided to allow safe and convenient execution of the work. Under no circumstances shall pipe or accessories be dropped into the trench.

Care shall be exercised to keep pipe clear of mud, dirt, and debris before and during pipe laying.

No pipe shall be laid in water, and precautions shall be taken to prevent trench water from entering the pipe. In no case shall water be allowed to rise in or above the pipe before the joint has become thoroughly set. No walking on or working over the pipe after it has been laid, except as may be necessary for backfill, will be permitted until the pipe is covered with a minimum of 24" of backfill.

After the trench is excavated to the subgrade specified, it shall be filled to grade with crushed stone (except where concrete is specified) to provide a firm and satisfactory bed, for the entire length of the sewer pipe. Pipe shall be laid to form a watertight joint with the next adjoining pipe, with the inverts in a straight line and grade as shown on the drawings. The pipe shall be laid in an upstream direction, with bells upstream. Engineer will allow no skipping of sections without prior approval.

Any pipe that has been disturbed after being laid shall be taken up, the joints cleaned, and the pipe properly re-laid. Before jointing pipe, all excess coating material, dirt or other debris shall be removed from the bell and spigot ends of pipe. Any material inside of pipe shall be removed.

### *CRADLES*

The crushed stone cradle required for gravity sewer pipe shall meet requirements for Class "B" aggregate, Grading "D" as defined by TDOT specifications. The crushed stone shall be deposited in the excavated trench

to grade, allowing for the sewer pipe wall thickness and providing "bell holes" for making joints. The sewer pipe shall be accurately laid to line and grade, and then crushed stone shall be carefully deposited and tamped around the pipe up to the spring line of the pipe, as shown on the drawings.

### *ENCASEMENT*

In some areas, concrete encasement may be required. Where lines have a clearance of less than 18" from potable waterlines, where lines have less than 3 feet of cover in roadways, where lines have less than 18" of cover in other areas, in streambeds, or any areas where directed by the Engineer, concrete encasement and cradle may be required. Concrete used shall be 4000 psi.

### *BACKFILL REQUIREMENTS*

Backfilling of excavated trenches in open cut shall commence as soon as possible after the sewer pipe is laid and the jointing and alignment are approved, but not until authorized by the Engineer.

All backfill in trenches within the limits of existing or proposed paved surfaces or shoulders, or where indicated in other places, shall be stone. The stone shall be crushed stone, crushed slag or washed gravel meeting the requirements of section 903.17 TDOT Specifications.

Backfill in other areas, where stone is not required, shall be selected excavated materials taken from the trench. If excavated material is not suitable, other backfill material from sources procured by the Contractor must be obtained by the Contractor with no expense to the Owner and must be approved by the Engineer. The selected material used in the area from the top of the pipe to two feet above the pipe and the top one-foot of the trench shall contain no rock. The backfill for the area in between may include rock fragments with the maximum dimension along any axis of the rock not exceeding six inches. The rock fragments shall be mixed with rock so the total amount of rock in the mixture does not exceed 33%. Any excavated material that is not suitable for backfill shall be removed from the project site at no expense to the Owner.

Backfill shall be compacted by wheel loading as indicated on the drawings or allowed by the Engineer. No backfill shall be compacted in any method that does not agree with pipe manufacturer's recommendations.

If backfill materials are dropped into the trench from a height exceeding 5 feet above the pipe or previously placed backfill, its fall shall be broken by means acceptable to Engineer.

Stone shall be used under all manholes for leveling to provide a firm stable foundation. The thickness shall be 6" minimum. Manholes in paved areas

must be backfilled with stone. Backfill under all pipes connecting to manholes shall be bedded with crushed stone for a length of three feet from the manholes and thoroughly compacted. Other backfill around manholes, except where stone is required, shall be selected material, placed in uniform layers and compacted to the satisfaction of the Engineer.

Backfill around ductile iron pipe shall be free of cinders, rubbish and other materials that would be injurious to the pipe. Backfill containing clay, sand, or gravel shall be used for backfilling within 24" of the iron pipe.

### *CHECK DAMS*

Check dams shall be installed in the bedding and backfill of all new or replaced sewer lines to limit drainage area subject to the French drain effect of gravel bedding. Dams shall consist of compacted clay bedding and backfill at least three feet thick to the top of the trench and cut into the walls of the trench two feet. Alternatively, concrete may be used, keyed into the trench walls. Dams shall be placed no more than 500 feet apart. Effort should be made to install the check dams upstream of each manhole and out of roadways. All stream crossings shall include check dams on both sides of the crossing.

### *BORES AND TUNNELING*

Where indicated on drawings, pipe shall be installed by boring method. In the event that line and grade cannot be obtained by boring, the Contractor shall be required, at his expense, to construct a lined, mined tunnel in lieu of a tunnel by boring. Should a mined tunnel be required, it should be anticipated by Contractor that the tunnel diameter would probably be a diameter larger than bore diameter specified, depending upon method used by Contractor.

The Contractor shall provide all materials and equipment necessary to perform boring operations. Backstops for boring shall be of sufficient strength and positioned to support the thrust of the boring equipment without incurring any vertical or horizontal displacement during such boring operations. The guide rails for the boring equipment may be of either timber or steel. They shall be laid accurately to line and grade maintained in this position until completion of the boring operations. When complete, bore pits shall be backfilled per trench specifications and compacted.

Bored casing pipe shall be installed using equipment that encases the hole as the earth is removed. Installation of casing pipe concurrently with boring is required. All joints in casing pipe shall be welded. Casing pipe shall extend through the entire fill or from ditch line to ditch line (cut sections) and be installed in a manner that will not disrupt traffic nor damage roadway grade



and surface. No water shall be introduced into the excavation. The pipe shall be supported in the casing pipe to prevent damage to bells or couplings.

Tunnels, where necessary, shall be excavated by full face, heading and bench, or multiple drift procedures. Other methods of tunnel excavation may be used when approved by the Engineer. All work shall be done under the supervision of a superintendent familiar with tunneling and the use of tunnel liner plates. Tunneling may begin at either end unless otherwise specified. When necessary to reach the entrance grade, a shaft having a minimum width of 8 feet and a minimum length of 12 feet shall be dug, and the shaft shall be sheeted and shored as necessary. Excavation for the tunnel shall be done in such a manner so as to closely conform to the outside shape of the liner plates.

The Contractor shall replace, at his expense, any liner plates that may be damaged during handling and placing. Coated plates shall be handled in a manner to prevent damage to the coating. The liner plates shall be assembled in accordance with the manufacturer's recommendations and at such time there will not be more than 2 feet of tunnel excavation ahead of the bolting up of plates. At the end of each workday, the Contractor shall construct a bulkhead inside the assembled liner plate at the construction face unless the Engineer specifically grants permission to omit the bulkhead.

Grout blocks shall be installed at each end after bolting of liner plates is complete. Voids occurring between the liner plates and excavation shall be force grouted through the grouting holes in the plates with such pressure that all voids will be filled. Grouting shall progress simultaneously with installation of the liner plates.

Bedding material, approved by the Engineer, shall be provided to the depth necessary to uniformly support the pipe barrel. This support shall be provided for the entire length of the tunnel.

#### *CONNECTIONS TO MANHOLES AND OTHER CONCRETE STRUCTURES:*

Connections made to existing pre-cast manholes (or other concrete structures) shall be made using a boot or by coring the manhole and using Link Seal, or equal. These flexible products shall be used to provide a watertight seal between the manhole wall and the pipe. Any damage made to manhole, or structure, during coring shall be repaired using a non-shrink grout.

Any connections made to new manholes shall be made using boots specified in manhole section.

Wall sleeves shall be used where shown.

## *SHEETING & BRACING*

The contractor shall furnish, place and maintain adequate sheeting and bracing as may be required to support the sides of the excavation. Sheeting and bracing may be used to prevent any movement of earth that could diminish the width of the excavation or cause damage to adjacent properties. If, in the opinion of the Contractor, Sheeting and Bracing is needed the Contractor shall discuss this with the Engineer. Sheeting may be of wood or steel and shall be of adequate strength for the excavation. Wherever possible, the sheeting and bracing shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If it is necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along where the sheeting will be driven. Care shall be taken to prevent voids outside the sheeting; but, if voids develop, they shall be immediately filled with selected sandy materials and compacted as directed by the Engineer. The Engineer may order sheeting and bracing to be left in place at locations. Sheeting left in place may be ordered to be cut off at any specified elevation, but in no case shall it be left in the ground. All voids created by the cutting off of the sheeting to be left in place shall be immediately filled with selected sandy materials and compacted as directed by the Engineer.

Sheeting and bracing left in place in open cut trenches, as shown on the drawings or as ordered by the Engineer, shall be paid for under the appropriate items of the Bid. If the Contractor elects not to remove certain sheeting and bracing, he will not be paid additionally for such sheeting and bracing left in place. The Engineer must approve any sheeting and bracing left in place at the contractor's option. All sheeting and bracing not to be left in place shall be carefully removed (after the backfill is complete) so as to not endanger the water pipe and other structures. All voids created by withdrawal of the sheeting shall be immediately filled with selected sandy materials and compacted as directed by the Engineer.

## *SEPARATION OF WATER MAINS AND SEWERS*

Water mains and sewer mains shall be separated per State of Tennessee requirements. They shall not be installed in the same trenches in any instances.

Whenever possible, sewer mains should be installed at least 10 feet horizontally from any water main. Should local conditions prevent a lateral separation of 10 feet, a sewer main may be laid closer than 10 feet if it is installed in a separate trench and if the elevation of the top of the sewer line is at least 18" below the bottom of the water main.

When the elevation of the sewer line cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

When it is impractical to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to the water main pipe and shall be pressure-tested to assure water-tightness.

*Utilities Relocation and Repair:* Contractor shall repair or pay for any repairs of any utility lines damaged during construction. No separate payment will be made to contractor for said repairs. All repair materials shall be equal to type of utility damaged and repaired to the satisfaction of the utility owner. All repair materials used on water and sewer lines shall meet State of Tennessee Regulations.

#### PART 4 – PAYMENT:

No direct payment will be made for any sewerline work unless it is listed in bid schedule. This work will be considered incidental to other work.

*END OF SECTION 2700*

## **SECTION 03001 – CONCRETE**

### **PART 1 – GENERAL**

***Refer to structural drawings for additional information. The notes on the structural drawings shall govern in the case of any discrepancies between the structural drawings and these specifications.***

#### **WORK INCLUDED:**

Form work, shoring, bracing and anchorage

Concrete reinforcement and accessories

Cast-in-place concrete

*This section does not apply to pre-cast structures.*

#### **RELATED WORK:**

The construction of the sub-grade, including compaction, is specified under Division 2. If the sub-grade is not in suitable condition at the time construction begins, it shall be put in proper condition by removing all unsuitable materials, backfilling all holes with well-compacted granular material, and bringing the surface to crown and elevation.

This Contractor shall build into the concrete work any recesses, inserts, anchors, sleeves, anchor bolts, etc. as required by all trades.

#### **REFERENCES:**

"Specifications for Structural Concrete for Buildings" ACI 301-84 (Revised 1987).

In addition to ACI 301-84, cast-in place concrete shall conform to ACI 305-R88 and ACI 306-R83 for Hot Weather Concreting and Cold Weather Concreting, respectively. The use of any methods described in ACI 305-R82 or ACI 306-83 shall be approved by the Engineer before implementation.

"Building Code Requirements for Reinforced Concrete", ACI 318-86.

"Standard Specification for Ready-Mixed Concrete", ANSI/ASTM C94-84.

ANSI C311-77, "Standard methods of Sampling and Testing Fly Ash for use as an Admixture in Portland Cement Concrete".

ANSI C618-80, "Standard Specifications for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete".

ANSI/ASTM A185 – Welded Steel Wire Fabric for Concrete Reinforcement

ASTM A615 – Deformed and Plain Billet-Steel for Concrete Reinforcement

ASTM C33 – Concrete Aggregates

ASTM C260 – Air Entraining Admixtures for Concrete

ASTM C309 – Liquid membrane – Forming Compounds for Curing Concrete

ASTM D2103 – Polyethylene Film and Sheeting

FS TT-C-800 – Curing Compound, Concrete, for New and Existing Surfaces

NOTE: The term "Standard Specifications" is used herein referring to ACI 301-84 (latest revision).

Materials and work shall conform to the requirements of standards, codes and recommended practices required in this section. A copy of all ACI references shall be kept available at the job site at all times.

### **TESTS:**

Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not prevent rejection when defect is discovered, nor shall it obligate the Owner for final acceptance.

Submit proposed mix design of each class of concrete to Engineer for review and acceptance prior to commencement of work.

The Contractor shall, at his own expense, obtain compression strength tests for each 150 cubic yards or fraction thereof, of each mix design of concrete placed in any one (1) day and for each 5,000 SF of surface area of slabs, pads or walks or fraction thereof place in one day. Contractor shall mold and cure four (4) cylinders and shall be tested (ASTM C39) at 7 days for information. One cylinder shall be tested at 28 days for acceptance. The remaining cylinders shall be tested only if irregularities occur during the handling or testing of the previous two (2) cylinders. Test results shall be submitted to the Engineer for review and acceptance.

One additional test cylinder will be taken during cold weather and be cured on site under same conditions as concrete it represents.

Strength level of concrete will be satisfactory if 90% of strength test results and averages of all sets of three consecutive strength test equal or exceed specified strengths and of individual test result is below strength by more than 500 psi.

Inspection and testing of concrete as delivered to the job site, other than compressive tests, will be performed by the Engineer. Tests for slump, air content, and any other test deemed necessary will be performed as needed. Concrete for testing will be taken from random samples. No payment will be made for concrete used for testing.

### ***SHOP DRAWINGS:***

Submit shop drawings of reinforcing steel.

Indicate reinforcement sizes, spacing, locations and quantities of reinforcing steel, bending and cutting schedules, splicing, supporting and spacing devices.

## ***PART 2 - PRODUCTS***

### ***FORM MATERIALS:***

Conform to ACI 301.

Furnish formwork as required to complete work.

2 x 4 shall be minimum size wood bracing members including those members used as edge form for slabs.

### ***REINFORCING STEEL:***

Reinforcing Steel: ASTM A615, 60 psi yield grade billet steel deformed bars; uncoated finish.

Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; in flat sheets or coiled rolls; uncoated finish.

### ***CONCRETE MATERIALS:***

Cement: ASTM C150, normal – Type 1 Portland, gray color.

Fine and Coarse Aggregates: ASTM C33.

Water: Clean and not detrimental to concrete.

### ***ADMIXTURES:***

Air Entrainment Admixture: ASTM C260.

Water-reducing, Set-controlling Admixture: ASTM C494-80. Type A (water-reducing and retarding), Type E (water-reducing and accelerating). If used, a qualified concrete technician employed by the manufacturer shall assist in proportioning concrete materials for optimum use, to advise on proper use of admixtures and adjustment of concrete mix proportions to meet job site and climatic conditions. Field inspection by employee representative during concrete placement will be required.

Fly Ash, conforming to ANSI/ASTM C618, Class F, except ignition loss, shall not exceed six percent (6%). Only one source of fly ash shall be used.

### ***ACCESSORIES:***

Bonding Agent: Agent to bond new concrete to existing concrete shall be Sondbond epoxy resin system as manufactured by Sonneborn Building Products, Inc., or equal.

Vapor Barrier: ASTM D2103, 6-mil thick clear polyethylene film.

Grouts (Non-Shrink): EPI Top 100 (Celanese Coating Co.): COLMAO-DUR or SIKASTIX 370 (SIKA Chemical Corp.): FX-75 HYDROESTER BONDING AGENT (Fox Industries) and FEL-POXY 102 (FEL-PRO Building Products, Inc.), or equal.

Construction Joints: "Dayton" 24 gage galvanized steel screen joint as shown on the drawings and shall be backed by 2 x full depth, or equal.

Expansion Joints shall be pre-molded of bituminous materials manufactured in accordance with the latest edition of ASTM standards. The joints shall run the full depth of the concrete. Non-extruding joint material shall be used in all exterior applications.

Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

Waterstop: Waterstop-RX (coiled rope containing sodium bentonite) or PVC understop, 3/8" x 12", ribbed with center bulb, or equal.

Anchors: Where permitted, shall be Hilti HVA Adhesive, or equal.

### ***CURING MATERIALS:***

Water: Clean and drinkable.

Absorptive Mat: Burlap-polyethylene, 8 oz./S.Y., bonded to prevent separation during use.

Absorptive Mat: Burlap fabric.

Membrane Curing Compound: ASTM C309. Material providing water retention not exceeding loss of 0.55 kg/m<sup>2</sup> when tested in accordance with ASNI/ASTM C156-80. Master Builders Masterseal or equal.

### ***CONCRETE MIX:***

Selection of Proportions: General – Concrete shall be composed of Portland Cement, 211.1-78 aggregate, water, fly ash, admixtures, and air-entraining admixture. Proportions of ingredients shall produce concrete that will work readily into corners and angles of forms, bond to reinforcement, without segregation or excessive bleed water forming on the surface. Proportioning of materials shall be in accordance with ACI 211.1-78, "Recommended Practices for Selecting Proportions for Normal, Heavy and Mass Weight Concrete".

Concrete mix for each strength of concrete required shall be submitted to Engineer for approval.

1. Proportions of ingredients shall be selected by past field experience or, in lieu of past performance; laboratory trial mixes to produce placability, durability, specified strength and properties specified.
  - (a) Maximum water-cement ratio: 0.45
  - (b) Minimum cement content:



<u>Coarse Aggregate No.</u>	<u>#per C.Y.</u>
467 (1 ½" maximum)	517
57 (1" maximum) or	
67 (¾" maximum)	564

Compressive strength of all concrete: 28 days; 4000 PSI

***Air Entrainment:***

Concrete subject to exposure shall be air-entrained. Total air content required (air-entrained and entrapped air) shall be:

<u>Normal Max. Size Coarse Aggregate</u>	<u>Total Air Content</u>
¾" (19 mm)	7% +/- 1
1" (25 mm)	6% +/- 1
1 ½" (38 mm)	5% +/- 1

1. Air content shall be measured by ANSI/ASTM C231-78, "Standard Test Method for Air Content of Freshly Mixed Concrete by Pressure Method".
2. Maximum total air content on troweled flatwork receiving a surface hardener shall be 3%.

***Slump:***

1. 1" minimum
2. Slabs, beams, walls, columns, 4" maximum
3. Footings, 3" maximum
4. Flowable concrete, with prior written approval from the Engineer, 8" slump, not to exceed 10".

***Aggregate Size:***

Maximum size of coarse aggregate shall not exceed:

1. One-fifth narrowest dimension between forms.

2. Three-fourths minimum clear spacing between reinforcing bars.
3. One-third the thickness of slabs.

***Temperature:***

When concreting at temperatures above 35° F, the aggregates or water shall be heated or cooled if necessary prior to being placed in the mixer so that the temperature of the resultant mixture will not be less than 50° F at the time of placement. If heating is required, the apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible injury to persons or damage to materials.

When concreting is authorized at temperatures 35° F or less, the Engineer will require the water or the aggregates or both to be heated to not less than 70° F nor more than 150° F. The temperature of the mixed concrete shall not be less than 60° F or more than 90° F at the time of placing.

***STONE BASE:***

Stone base for slab-on-grade, minimum 6" compacted thickness, shall be crushed run stone, Tennessee Department of Transportation, Class "B" aggregate, Grading "D" compacted to 75% of as-placed volume. Stone base under basin slabs shall be compacted per Soils Report.

***PART 3 – EXECUTION***

***FORMWORK ERECTION:***

Examine the drawings carefully and provide all recesses and all openings of the sizes and shapes required or as may be directed by the Engineer for the installation of all work requiring openings. Furnish all forms of the size and shapes necessary except where sleeves are specified under other sections of the specifications.

Section 4.1.3 of the standard specifications is revised to permit forms of footings to be omitted when the soil and the workmanship permit accurate excavation to size and if omission is approved by the Engineer.

Removal of forms shall be done in a manner which will assure complete safety of the structure. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to support their weight and the loads thereon safely. Remove forms of exposed concrete carefully without injury to lines and edges.

**REINFORCEMENT:**

Place reinforcement and support to prevent displacement.

Reinforcing splices shall have minimum lap of 30 diameters.

All welded wire fabric shall be placed in accordance with Section 5.5.4 of the standard specifications.

**PLACING CONCRETE:**

Notify Engineer a minimum of 24 hours prior to commencement of concreting operations.

Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40° F, and not resumed until an ascending air temperature in the shade and away from artificial heat reaches 35° F.

Preparation – Contractor shall provide access for delivery, provide sufficient equipment and manpower to rapidly place all concrete.

Framework shall have been completed and snow, ice, water, debris removed from within forms.

Expansion joint materials, anchors and all embedded items shall have been positioned.

Sub-grades shall be sprinkled sufficiently to eliminate water loss from concrete if vapor barrier is not required.

Install vapor barrier under all floor slabs on grade. Lap joints minimum 6 inches. Install one layer of vapor barrier continuously under all slabs on grade. Lap joints 6 inches. Turn up membrane at vertical surfaces full thickness of slab, and lap separate strip of membrane to provide double thickness. Seal around all pipes and conduits penetrating the membrane in accordance with the membrane manufacture's recommendations. Do not disturb vapor barrier while placing reinforcement.

All exterior construction joints must have a water stop installed when the construction joint is below grade.

Concrete shall not be placed on frozen ground.

Conveying – Concrete shall be placed rapidly by methods to prevent segregation or loss of quality.

Placement – Concrete shall be deposited continuously or, when continuous placement is not possible, construction joints shall be located as approved by Engineer. Concrete shall be placed as nearly as possible to its final position. Avoid rehandling.

1. Concrete shall be consolidated by vibration, spading, rodding, or forking. Work concrete around reinforcement embedded items and into corners; eliminate air or stone pockets and other causes of honeycombing, pitting or planes of weakness.
2. Internal vibration shall have a minimum frequency of 8000 v/min. with amplitude to consolidate effectively.
  - a. Vibrators shall be operated by competent workers.
  - b. Use of vibrators to transport concrete will not be allowed.
  - c. Vibrators shall be inserted and withdrawn approximately every 18 inches for 5 to 15 seconds each time.

Saw cut control joints at an optimum time after finishing. Cut slabs with 3/16" thick blade, cutting 1/4 of depth of slab thickness.

Separate exterior slabs on grade from vertical surfaces by turning up 6-mil poly V.B.

Sections of walls shall be maximum of 30 feet between construction joints with placement within each section made continuously to produce a monolithic unit. At least 48 hours should elapse between castings of adjoining units.

Wall sleeves shall be used in locations where piping and conduits pass through concrete walls and shall be caulked watertight.

### ***FINISHES (CAST-IN-PLACE STRUCTURES):***

Finish for walls, sidewalks, equipment pads and curbs shall be broom finish.

Interior slabs shall receive a steel troweled finish. This does not apply to slabs inside basins, but to slabs inside buildings.

All formed concrete shall be "smooth form finished" as defined by Section 10.2.2 of ACI 301-72. All tie holes and defects shall be patched and fins completely removed. All interior (including areas under water level) and all exposed exterior surfaces above grade shall receive two coats of Thoroseal, or equal. All exposed exterior surfaces above grade shall receive one coat of Thorosheen, or equal.

#### ***TOLERANCES:***

Surfaces which are to receive troweled finish or broom finish shall be built to a true plane within 1/8 inch in 10 feet as determined by a 10 foot straightedge placed anywhere on the slab in any direction.

Surfaces which are to receive scratched finish or floated finish shall be built to a true plane within 1/4 inch in 10 feet as determined above.

#### ***CURING AND PROTECTION:***

Immediately following placement, concrete shall be protected from premature drying, hot and cold temperatures, rain, flowing water and mechanical injury.

Material and method of curing shall be approved by Engineer. Final curing shall continue for not less than 7 days.

1. Approved methods include: ponding or continuous sprinkling, continuous wet mats, sand kept continuously wet and liquid membrane-forming compounds.
  - a. Applications of waterproof sheet material shall conform to ANSI/ASTM C171-69 (Re-approved 1975), "Standard Specification for Sheet Materials for Curing Concrete".
    1. Material shall maintain a maximum moisture loss of 0.55 kg/m<sup>2</sup> tested in accordance with ASTM/ASTM C156-80, "Standard Test Method for Water Retention by Concrete Curing Materials".
  - b. Application of membrane-forming compounds shall conform to ANSI/ASTM C309-81, "Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete", Master-Seal, manufactured by Master Builders, or equal.

**CONCRETE GROUT:**

Grout shall be mixed in quantities as needed and shall not be retempered or used after it has begun to set. The grout shall consist of one part Portland Cement (Portland Cement, AASHTO Spec. M-85) and two parts of sand by volume mixed with sufficient water to form a grout of proper consistency. When non-shrinking or non-shrinking fast setting grout is used, it shall be formulated by the incorporation of an admixture, or a pre-mixed grout may be used. The formulation and the admixture or the pre-mixed grout used will be subject to the approval of the Engineer, and shall be mixed and used in accordance with the recommendations of the manufacturer. Water for the grout shall be clean and free from silt or suspended solids. Bonding agent shall be used to bond grout on existing concrete.

**SAND:**

Sand for grout shall be uniformly graded from coarse to fine within the following limits (TN D.O.T. 903.02)

<u>Sieve Size</u>	<u>Total Percent Passing by Weight</u>
No. 8	100
No. 50	15-40
No. 100	0-10
No. 200	0-5

**PART 4 - PAYMENT**

Concrete Work shall be included in lump sum price for project.

**END OF SECTION 03001**

## **SECTION 05500 METAL FABRICATIONS**

### ***PART 1 – GENERAL***

#### ***RELATED DOCUMENTS:***

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to work of this Section.

#### ***SUMMARY:***

This section includes the following metal fabrications:

- Miscellaneous Steel Trim
- Aluminum Bar Gratings and Support Systems
- Aluminum Pipe Railings
- Aluminum Stairs
- Steel Equipment Supports
- Anchors for Masonry Work
- Access Platforms
- Weir troughs and supports
- Miscellaneous Metals

#### ***DEFINITIONS:***

Definitions in ASTM E 985 for railing-related terms apply to this section.

#### ***SYSTEM PERFORMANCE REQUIREMENTS:***

Structural Performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of International Building Code for Occupant load No Greater than 50.

Aluminum Grating: Capable of withstanding a uniform load of 200 lbf per sq. ft. with a maximum deflection of 1/4".

***SUBMITTALS:***

General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Section.

Product Data for products used in miscellaneous metal fabrications, including paint products and grout.

Shop Drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.

Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

***PROJECT CONDITIONS:***

Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

***SEQUENCING AND SCHEDULING:***

Sequenced and coordinate installation of wall handrails as follows:

Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.

Mount handrails only on gypsum board assemblies reinforced to receive anchors, and where the location of concealed anchor plates has been clearly marked for benefit of Installer.



## **PART 2 - PRODUCTS:**

### **FERROUS METALS:**

Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

Steel Plates, Shapes, and Bars: ASTM A 36.

Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

Concrete Inserts: Threaded or wedge type; stainless steel. Provide bolts, washers, and shims as required.

### **ALUMINUM:**

See Specifications Below:

### **FASTENERS:**

General: Provide stainless steel fasteners. Select fasteners for the type, grade, and class required.

### **PAINT:**

Shop Primer for Ferrous Metal: See Section 09900 of these Specifications.

Field Coat for Ferrous Metal: See Section 09900 of these Specifications.

### **FABRICATION, GENERAL:**

Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated and specified for various components of each metal fabrication.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

Remove sharp or rough areas on exposed traffic surfaces.

Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.

Fabricated joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

### ***MISCELLANEOUS FRAMING AND SUPPORTS:***

General: Provide framing and supports for applications indicated or which are not part of structural framework, as required to complete work.

Panel Supports: Aluminum frames are to be furnished made of 3" x 3" x 1/4" aluminum angles that will support the equipment control panel, disconnects, etc. that will allow the panels (or boxes) to be mounted approximately 4 feet above ground unless otherwise shown on drawings.

Fabricated units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

## **METAL BAR GRATINGS:**

Aluminum grating shall be fabricated of I-shaped bars, alloy 6063-T6, with swaged cross bars spaced on 4" centers. Bearing bars shall be spaced on 1 3/16" centers. Top surface of bearing bars shall be striated to provide a non-slip surface.

Grating shall be designed to support a uniform load of 200 pounds per square foot with a maximum deflection of 1/4". The maximum fiber stress shall not exceed that which is allowed by the Aluminum Association.

Standard installation clearances and tolerances shall conform to the requirements of the current Metal Bar Grating Manual published by the National Association of Architectural Metal Manufacturers.

Aluminum frames embedded in concrete shall incorporate a recess under the horizontal bearing leg to receive the hold down fasteners. The frames shall be TF1.25A thru TF2.50A as manufactured by Thompson Fabricating, LLC (Birmingham, AL), or equal.

Install aluminum clamps or clips to anchor the grating securely to supports. A minimum of 4 fasteners per panel shall be provided, unless otherwise shown on the drawings.

Cutouts for circular obstructions are to be at least 2" larger in diameter than the obstruction. Cutouts for all piping 2" in diameter or less shall be made in the field. Band all ends of grating.

Aluminum shelf angles shall be anchored to the concrete using stainless steel (type 18-8) wedge anchors.

Aluminum stair treads shall be I-bar grating type with an extruded aluminum corrugated nosing.

Paint all aluminum surfaces in contact with concrete or dissimilar metals with a shop coat of bituminous paint.

### Coordination:

Arrange supports for stairs, grating and other to allow for operation of any equipment or installation of piping as shown. Fabricate cutouts in grating sections for penetrations required (slide gates, piping, valves, etc.). Arrange layout of cutouts to permit grating removal without disturbing items penetrating gratings.

Edge band openings in grating that interrupt 4 or more bearing bars of same size and material as bearing bars.

Do not notch bearing bars at supports to maintain elevation.

### ***ALUMINUM GUARDRAILS, HANDRAILS, AND RAILINGS:***

All guardrails, handrails and railings shall meet the design specifications for Factory-Industrial Guardrail, International Building Code for Occupant Load No Greater Than 50. They shall also meet OSHA Specifications.

Guardrails and Handrails shall be the product of a company normally engaged in the manufacture of pipe railing. Railings shall be shop assembled in lengths not to exceed 24 feet for field erection.

The handrail shall be made of pipes joined together with component fittings. Samples of all components, bases, toe plate and pipe must be submitted for approval at the request of the engineer. Components that are pop-riveted or glued at the joints will not be acceptable. All components must be mechanically fastened with stainless steel hardware. Handrail and components shall be TUFRAIL, as manufactured by Thompson Fabricating, LLC (Birmingham, Alabama) or equal.

Railings shall be 1 1/2" Schedule 40 aluminum pipe alloy 6105-T5, ASTM-B-429 or ASTM-B-221. Post shall be 1 1/2" Schedule 40 aluminum pipe of the same alloy. Post spacing shall be a maximum of 6'-0".

Guardrails and Handrails shall be designed to withstand a 200lb concentrated load applied in any direction and at any point on the top rail. Guardrails and Handrails shall also be designed to withstand a uniform load of 20 lb/ft applied horizontally to the top rail. Uniform loads are not to be applied simultaneously with the concentrated loads.

Intermediate railings shall be provided such that a 21-inch diameter sphere cannot pass through any opening.

Intermediate railings shall be designed to withstand a horizontally applied normal load of 50lb on an area not to exceed one square foot including openings and spaces between rails.

The manufacturer shall submit calculations for approval at the request of the Engineer. Testing of base castings or base extrusions by an independent lab or manufacturer's lab (if manufacturer's lab meets the requirements of the Aluminum Association) will be an acceptable substitute for calculations. Calculations will be required for approval of all other design aspects.

Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations (OSHA 1910.23). The top surface of the top railing shall be smooth and shall not be interrupted by projected fittings.

The mid-rail at a corner return shall be able to withstand a 200lb load without loosening. The manufacturer is to determine this dimension for their system and provide physical tests from a laboratory to confirm compliance.

Concrete anchors shall be stainless steel type 303 or 304 wedge anchors and shall be furnished by the handrail manufacturer. The anchor design shall include the appropriate reduction factors for spacing and edge distances in accordance with the manufacturers published data.

Toeboard shall conform to OSHA standards. Toeboard shall be a minimum of 4" high and shall be an extrusion that attaches to the posts with clamps that will allow for expansion and contraction between posts. Toeboard shall be set 1/4" above the walking surface. Toeboards shall be provided on handrails as required by OSHA and/or as shown on drawings. Toeboards shall be shipped in stock lengths for field installation.

A self-closing gate shall guard Openings in the railing (OSHA 1910.23). Safety chains shall not be used unless specifically shown on the drawings.

Finish shall be Aluminum Association M10-C22-A41 (215-R1). The pipe shall be plastic-wrapped. The plastic wrap is to be removed after erection.

Aluminum surfaces in contact with concrete, grout or dissimilar metals will be protected with a coat of bituminous paint, Mylar isolators or other approved material.

### ***PART 3 – EXECUTION:***

#### ***PREPARATION:***

Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

## ***INSTALLATION - GENERAL:***

Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connections as required. All anchorage devices and fasteners shall be coordinated with tank supplier so that no damage is done to tank and the tank can be designed to accommodate the loading and stresses.

Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

Provide temporary bracing or anchors in framework for items that are to be built into concrete, masonry or similar construction.

Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with heavy coat of bituminous paint or zinc chromate primer.

## ***INSTALLATION OF METAL BAR GRATING:***

General: Install gratings to comply with recommendations of NAAMM grating standard referenced under Part 2 that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

Secure removable units to supporting members with type and size of clips and fasteners indicated, or if not indicated as recommended by grating manufacturer for type of installation conditions shown.

Secure nonremovable units to supporting members by welding where both materials are the same; otherwise, fasten by bolting as indicated above.

## ***INSTALLATION OF RAILINGS AND HANDRAILS:***

Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Anchor posts and railing ends in concrete with grout.

Field fabrication of the railing system is not permitted.

Set handrails plumb within 1/8" of vertical and align horizontally to within 1/8" in 12 feet.

Install wedge anchors to proper depth to develop full pullout and shear values. Check all fasteners and bolts in base connections and splices for tightness.

Adequate provisions for expansion and contraction shall be incorporated into the rails. Expansion joints shall be placed at 60 foot intervals and at all concrete expansion joints.

Toeboards shall be shipped loose and attached to the handrail in the field. Attachment to the posts will be made with clamps which allow for expansion and contraction while maintaining a straight line.

All defective, damaged or otherwise improperly installed handrails shall be removed and replaced with material which complies with this section at no additional cost to the Owner.

Following installation, aluminum handrail shall be cleaned with mild soap and clean water. Acid solutions, steel wool, or harsh abrasives shall not be used.

### ***PAYMENT :***

Payment for any metal fabrications will be part of lump sum price for project.

## ***END OF SECTION 05500***

## **SECTION 09900** **PAINTING**

### *PART 1 – GENERAL*

#### *WORK INCLUDED:*

This specification covers preparation of surfaces, performance and completion of painting of all surfaces as required by the drawings and as specified herein. This section does not apply to pre-engineered metal building / cover.

#### *SYSTEM DESCRIPTION:*

Performance Requirements: Include the following performance data as certified by a qualified testing laboratory:

1. Abrasion – ASTM D 4060, CS-17 Wheel, 1,000 grams load.
2. Adhesion – ASTM D 3359 Method B.
3. Exterior Exposure – Exposed at 45 degrees facing ocean (Atlantic Sea Coast)
4. Hardness – ASTM D 3363-74
5. Humidity – ASTM D 2247-68
6. Salt Spray (FOG) – ASTM B 117-73

#### *QUALITY ASSURANCE:*

All materials specified herein meet the current regulations in effect for the emission of Volatile Organic Compounds (V.O.C.) for the State and Federal Governments.

Coating materials specified in contact with Potable Water must be approved in writing by both the State of Tennessee Division of Water and by the current Federal regulatory authority in effect at the time of application.

#### *DELIVERY, STORAGE AND HANDLING:*

All materials shall be delivered to jobsite in original sealed and labeled containers of the paint manufacturer.

#### *PROJECT/SITE CONDITIONS:*

Coatings shall be applied during good painting weather. Air and surface temperatures shall be within limits prescribed by the manufacturer for the coating being applied and work areas shall be reasonably free of airborne dust at the time of application and while coating is drying.



## *PART 2 – PRODUCTS*

### *MATERIAL QUALITY:*

Provide best quality grade of various types of coatings and regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

Federal specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provide, meet or exceed these minimums.

Manufacturer's products which comply with coating quantitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Designer. Furnish material data and manufacturer's certificate of performance to Design for any proposed substitutions.

Provide undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

### *MATERIALS:*

Where brand names are used in this section, they are used as a general descriptive reference only. Use of other brands of equal quality and performance will be permitted.

Colors, where not specified, shall be as selected by the Engineer.

## *PART 3 – EXECUTION*

### *EXAMINATION:*

Examine surfaces prior to surface preparation and determine if they are suitable to proceed in accordance with paint manufacturers recommendations. Commencement of application implies acceptance of substrate and responsibility thereof.

### *SURFACE PREPARATION:*

#### *General:*

Prepare surfaces in accordance with coating system's specifications. Surfaces shall be cleaned. Touch up welds, burned and abraded areas with specified primer before applying field coats.

Allow each coat to dry thoroughly before applying next coat.

Finish coats shall be uniform in color and sheen without streaks, laps, sags or missed areas. Primer and finish coats shall be furnished from the same manufacturer to ensure compatibility.

All surface preparation and repairs shall be approved by the Engineer/Owner before primer is applied.

Correct work that is not acceptable and request re-inspection.

*Steel, Non-Immersion Service – Structural, Tanks, Pipes, and Equipment:*

To be prepared in accordance with Steel Structures Painting Council recommendations for an SSPC-SP6 Commercial Blast Cleaning.

*Steel, Immersion Service – Structural, Tanks, Pipes and Equipment, and Mill Coated Steel Pipe:*

To be prepared in accordance with Steel Structures Painting Council recommendations for an SSPC-SP10 Near-White Blast Cleaning.

*Metal Anchorage for Buried Piping:*

To be prepared in accordance with Steel Structures Painting Council recommendations for an SSPC-SP3 Power Tool Clean.

*Factory Primed Steel and Mill Coated Steel Pipe (Non-Immersion):*

Surface shall be clean and dry.

*Concrete, Dense Masonry and Porous Masonry:*

Exterior, Non-Immersion – Surface shall be clean and dry. New concrete will be cured a minimum of 28 days.

Immersion – Brush-Off Blast. New concrete will be cured minimum of 28 days. Fill flush all bug holes and voids with TNEMEC or Thoroseal or other filler and surfacer product compatible with finish coat, or equal.

*Plaster, Wallboard, Wood and Insulated Pipe:*

Interior/Exterior – Surface shall be clean and dry.

**APPLICATION:**

Materials shall be mixed, thinned and applied according to the manufacturer's printed instructions and in accordance with AWWA D 102-78.

### *CLEANUP:*

Remove and dispose of all rubbish or other unsightly material, in a legal manner, leaving the premises in a clean condition.

### *PROTECTION:*

Request acceptance of each coat before applying succeeding coats.

Correct work that is not acceptable and request re-inspection.

### *PAINTING SCHEDULE:*

#### *Steel – Structural, Tanks, Pipes and Equipment:*

1. Exterior, Non-Immersion
  - 1<sup>st</sup> Coat: Apply Tnemec Series 66-1255 Hi-Build Expoxoline at 4.0-6.0 mils DFT, or equal.
  - 2<sup>nd</sup> Coat: Apply Tnemec Series 73-Color Endura-Shield III at 3.0-5.0 mils DFT, or equal.
2. Immersion, Potable or Non-Potable Water
  - 1<sup>st</sup> Coat: Apply Tnemec Series 66-1255 Hi-Build Expoxoline (\*) at 3.0-5.0 mils DFT, or equal.
  - 2<sup>nd</sup> Coat: Apply Tnemec Series 66-Color Hi-Build Epoxoline (\*) at 4.0-6.0 mils DFT, or equal.

\* Use Tnemec Series 20 Poto-Pox in Potable Water, or equal.
3. Immersion, Non-Potable water with high levels of Hydrogen Sulfide (Pump Stations)
  - 1<sup>st</sup> Coat: Apply Tnemec Series 120-5002 Vinester at 12.0-18.0 mils DFT, or equal.
  - 2<sup>nd</sup> Coat: Apply Tnemec Series 120-5001 Vinester at 12.0-18.0 mils DFT, or equal.

4. Interior, Non-Immersion

1<sup>st</sup> Coat: Apply Tnemec Series 66-1255 Hi-Epoxoline at 3.0-5.0 mils DFT, or equal.

2<sup>nd</sup> Coat: Apply Tnemec Series 66-Color Hi-Build Epoxoline at 4.0-6.0 mils DFT, or equal.

5. Metal Anchorage for Buried Piping

1<sup>st</sup> Coat: Apply Tnemec Series 46-450 Heavy TnemeCol at 13.0-16.0 mils DFT, or equal.

6. Miscellaneous Castings, Including Manhole Rings and Covers

One Coat: Apply Tnemec Series 46H-413 Hi-Build Tneme-Tar at 12.0-16.0 mils DFT, or equal.

7. Factory Primed

Intermediate Coat: Apply Tnemec Series 50-330 Poly-Ura-Prime at 2.0-3.0 mils DFT, or equal.

Finish Coat: See top coat for exposure. System 3.06 A. 1,2,4, or 6.

Mill Coated Steel Pipe:

1. Exterior of Pipe, Non-Immersion

1<sup>st</sup> Coat: Apply Tnemec Series 66-1255 Hi-Build Expoxoline at 4.0-6.0 mils DFT, or equal.

2<sup>nd</sup> Coat: Apply Tnemec Series 73-Color Endura-Shield III at 3.0-5.0 mils DFT, or equal.

2. Immersion, Potable or Non-Potable Water

1<sup>st</sup> Coat: Apply Tnemec Series 66-1255 Hi-Build Expoxoline (\*) at 3.0-5.0 mils DFT, or equal.

2<sup>nd</sup> Coat: Apply Tnemec Series 66-Color Hi-Build Epoxoline (\*) at 4.0-6.0 mils DFT, or equal.

\* Use Tnemec Series 20 Poto-Pox in Potable Water, or equal.

Concrete: No coatings are required for Floors and sidewalks. See Section 03001 for additional specifications.

Porous Masonry:

1. Exterior  
Primer: Sherwin-Williams Heavy Duty Block Filler, B42W46, 10 mils DFT, or equal.  
  
Finish: Two (2) coats Sherwin-Williams A-100 Satin Latex House and Trim, 1.5 mils DFT, or equal.
2. Interior  
  
Primer: Apply Sherwin-Williams Pro Mar 200 Latex Wall Primer, 1.1 mils DFT, or equal.  
  
Finish: Apply two (2) coats of Sherwin-Williams Pro Mar 200 Alkyd Semi-Gloss Enamel, 17 mils DFT, or equal.

Plaster and Wallboard:

1. Interior  
  
Primer: Apply Sherwin-Williams Pro Mar 200 Latex Wall Primer, 1.1 mils DFT, or equal.  
  
Finish: Apply two (2) coats of Sherwin-Williams Pro Mar 200 Alkyd Semi-Gloss Enamel, 17 mils DFT, or equal.

Wood:

1. Interior  
  
Primer: Apply Sherwin-Williams Pro Mar 200 Latex Wall Primer, 1.1 mils DFT, or equal.  
  
Finish: Apply two (2) coats of Sherwin-Williams Pro Mar 200 Alkyd Semi-Gloss Enamel, 17 mils DFT, or equal.
2. Exterior  
  
Primer: Apply Sherwin-Williams A-100 Exterior Wood Primer, Y24W20, 2.2 mils DFT, or equal.

Finish: Apply two (2) coats of Sherwin Williams Pro Mar Alkyd Flat House Paint, 1.8 mils DFT, or equal.

Insulated Pipe:

1. Interior

1<sup>st</sup> Coat: Apply Tnemec Series 6/7-Color Tneme-Cryl at 2.0-3.0 mils DFT, or equal.

2<sup>nd</sup> Coat: Apply Tnemec Series 6/7-Color Tneme-Cryl at 2.0-3.0 mils DFT, or equal.

Non-Ferrous Metals:

1. Interior

One Coat: Apply Tnemec Series 66-Color Hi-Build Epoxoline at 4.0-6.0 mils DFT, or equal.

2. Exterior

1<sup>st</sup> Coat: Apply Tnemec Series 66-1255 Hi-Build Expoxoline at 4.0-6.0 mils DFT, or equal.

2<sup>nd</sup> Coat: Apply Tnemec Series 73-Color Endura-Shield III at 3.0-5.0 mils DFT, or equal.

*END OF SECTION 09900*

## **SECTION 11200 –** **ULTRAVIOLET DISINFECTION SYSTEM**

### ***PART 1 – GENERAL:***

#### ***1.1 SCOPE:***

This section describes the work to be done related to the installation of a 20 MGD ultraviolet disinfection system. A new concrete structure is to be constructed with two channels. The ultraviolet disinfection system will be installed in the channels. There is an existing gravity sewer line from the secondary clarifiers to the effluent flume. The new structure will be installed in the same location as the line and will be connected to the existing line on each end.

The system will be operated using signal from the existing effluent flow meter to control the flow through the system. There is to be automatic control gates at the head of each channel that regulates the flow through the channels.

The design shown on the construction drawings was designed around a TrojanUVSigna System. Other brands with equal performance and quality will be accepted. However, any rework, additional labor or materials, redesign or other actions that are necessary for an alternate brand will not be considered for direct payment but will be part of the alternate equipment price.

The contractor is to furnish all materials, labor, equipment, permits and other things necessary for the ultraviolet disinfection system work described in these specifications and/or as shown on drawings so that the finished system is completely operational and functions as designed. The UV System includes the flow control gates, gate controllers, weirs, UV system, control panels and all other components necessary for a complete operational system. All components must come from the same supplier.

#### ***1.2 ALTERNATES:***

The base bid (shown in bid form) is for a complete ultraviolet system as shown on the drawings and included in these specifications. There is a space for the bidder to include prices for up to two other alternate brands of systems. The bidder is to include in the alternate bid price the cost to furnish detail drawings for any required changes to concrete structure, flow controls, electrical design or other modifications that would be required for the alternate brand of system. The alternate price is also to include any additional materials, valves, piping, controls, structures, excavation or any other modifications that would be required for the alternate brand of equipment for a complete operational system meeting the same performance and quality requirements as the specified system.

The alternate deduct price for an alternate brand of equipment would be the overall difference in price. The deduct price shall include not only the difference in the equipment price (alternate equipment in lieu of base bid equipment) but shall ALSO include any costs added to the equipment price for the redesign costs, additional labor and materials required.

If significant changes are required to the design by using the alternate equipment, the bidder would be required to submit drawings prepared by an engineer (licensed in the State of Tennessee) and such changes would have to be approved by TDEC prior to construction.

If alternate brands are submitted by the low bidder, the low bidder will be required to furnish (within 5 days of the bid opening) the following:

- 1) List of at least 10 recent similar installations with references for each alternate brand (names and phone numbers),
- 2) List of all differences between specified system and proposed systems. This is to include a detailed description of all exceptions taken to the specifications.
- 3) List and sketches illustrating the changes that would be required in the structures, piping and electrical system that are not to be furnished by the equipment manufacturer but are required for a complete installation. These shall be site specific.
- 4) A bioassay validation report and calculation justifying the sizing for the proposed reactor (completed by a third party). See quality assurance section of specifications.
- 5) Detailed proposal of equipment offered, including the number of lamps proposed, calculations, power demands, design criteria, etc.
- 6) Detailed description of how the system is proposed to operate at 0 MGD flow, 3 MGD, 7 MGD, and 20 MGD and how the system will be controlled at these various flow rates.
- 7) The manufacturer of alternate brand is to include in the proposal documentation that all components that are proposed to be installed below elevation 1311 (100 year flood elevation) will not sustain any damage caused by flooding. The manufacturer shall also state what would be required to be installed above the 1311 elevation.

## *PART 2 – MATERIALS:*

### 2.1 DESCRIPTION

Furnish all labor, materials, equipment and appurtenances required to provide an open channel, gravity flow, and low pressure high intensity ultraviolet lamp (UV) disinfection system complete with an automatic chemical/mechanical cleaning



system and variable output lamp drivers. The UV system shall be complete and operational with all control equipment and accessories as shown and specified herein. This system will be capable of disinfecting effluent to meet the water quality standards listed in this section.

The ultraviolet disinfection system included in these specifications and used in the design is a Signa model manufactured by Trojan Technologies (See section 1.2 for alternate brands). The equipment will be purchased by the Contractor. The system is to be installed by the Contractor and tested and commissioned by Trojan Technologies (See section 1.2 for alternate brands), as specified in this section. The system shall also include flow control gates and automatic controllers as specified in this section.

## 2.2 QUALITY ASSURANCE

Any alternate UV manufacturer may be included as an alternate bid. However, the alternate bid price must include not only the equipment price but the cost of any additional materials and labor, excavation, redesign costs, etc. The alternate design must meet the same performance and quality as the system included in the base design. In comparing the base bid to alternate brands some of the items that will be considered to determine the "quality assurance" of the alternate brand are:

1. The manufacturer will be regularly engaged in the design, manufacture and servicing of UV systems for municipal wastewater disinfection. Manufacturer to submit evidence of a proven track record with at least ten (10) operating UV installations at municipal wastewater treatment plants over a design flow of 5 MGD in the USA for more than ten years.
2. The manufacturer will provide documentation of previous experience with municipal UV disinfection systems in wastewater applications with variable output electronic drivers and automatic cleaning systems.
3. For evaluation, the manufacturer will submit a reactor (bioassay) validation report and calculation justifying the sizing for the proposed reactor, without exception. The bioassay will have been completed by an independent third party and have

followed applicable sections and protocols described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse. The bioassay must demonstrate that the proposed UV system design and number of lamps will deliver the specified Reduction Equivalent Dose (RED) based on the water quality and operating conditions specified herein.

4. Independent certification of the lamp aging factor must be submitted if values other than the specified default values are being proposed. The lamp aging (or end-of-lamp-life) factor must be determined using the protocol described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse.
5. Independent certification of the fouling factor shall only be accepted if performed on the UV lamp and quartz sleeve combination equal to that being proposed by the UV manufacturer. The fouling factor must be conducted on municipal wastewater effluent using the protocol described in the NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse .
6. Documentation of UV manufacturer's service capabilities including location and experience.
7. Sample of lifetime disinfection performance guarantee including scope and duration of guarantee.
8. Alternate design submittals from manufacturers will include a complete and detailed proposal of equipment offered, including the number of lamps proposed, bioassay calculation and a detailed description of all exceptions taken to the specification.

## 2.2 DESIGN CRITERIA

1. Provide equipment that will disinfect effluent with the following characteristics:

- |                       |        |
|-----------------------|--------|
| a) Current Peak Flow: | 20 MGD |
| b) Average Flow:      | 7 MGD  |
| c) Minimum Flow:      | 0 MGD  |

- d) Total Suspended Solids: 30 mg/L, Maximum grab samples
  - e) Effluent Temperature Range: 33 to 85 °F
  - f) Ultraviolet Transmittance @ 253.7 nm: 65%, minimum
  - g) Effluent standards to be achieved: 126 E.coli/100 ml based on a 30 day Geometric Mean of daily samples and 487 E.coli/100 ml based on a 1 day Maximum for the effluent standard as specified in a) through f). Effluent standards will be guaranteed regardless of influent count to UV system.
2. The UV system is to be installed in 2 open channels having the following dimensions (not including the water level controller):
- a) Length: 24 ft
  - b) Width: 3.6 ft
  - c) Depth: 7.8 ft
3. The minimum regulated effluent depth in the channel will be 63.5 inches .
4. System configuration:
- a) The UV system must fit within the UV channels as stated without modification.
  - b) The UV system configuration will be as follows:
    - Number of Channels: 2
    - Number of Banks per Channel: 2
    - Lamps per Bank: 14
    - Total Number of Lamps in the UV System: 56
    - Number of System Control Centers: 1
    - Number of UV Sensors: 1 per bank
    - Number of Power Distribution Centers: 2
    - Number of Level Controllers: 2
    - Number of Hydraulic System Centers: 2

## 2.3 PERFORMANCE REQUIREMENTS

1. Provide a UV disinfection system complete with UV Banks and lifting mechanism, System Control Center, Power Distribution

Centers, and Water Level Controllers as shown on the contract drawings and as herein specified.

2. The ultraviolet disinfection system will produce an effluent conforming to the following discharge permit: 126 E.coli/100 ml, based on a 30 day Geometric Mean. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in *Standard Methods for the Examination of Water and Wastewater, 21<sup>st</sup> Ed.*
3. To ensure thorough characterization and disinfection performance of the UV reactor, two challenge organisms will be used in the validation testing. One challenge organism with low UV resistance (e.g. T1 with resistance of  $\sim 5$  mJ/cm<sup>2</sup> per log inactivation) and a second challenge organism with higher UV resistance (e.g. MS2 with resistance of  $\sim 20$  mJ/cm<sup>2</sup> per log inactivation).
4. The UV system will be designed to deliver a minimum MS2 RED of 30 mJ/cm<sup>2</sup> at peak flow, in effluent with a UV Transmission of 65% at end of lamp life (EOLL) after reductions for quartz sleeve fouling. The basis for evaluating the RED will be the independent third party bioassay, without exception. Bioassay validation methodology to follow applicable protocols described in NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse.*
5. The RED will be adjusted using an end of lamp life factor of 0.5 to compensate for lamp output reduction over the time period corresponding to the manufacturer's lamp warranty. The use of a higher lamp aging factor will be considered only upon review and approval of independent third party verified data that has been collected and analysed in accordance with protocols described in the NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse.*
6. The RED will be adjusted using a quartz sleeve fouling factor of 0.8 to compensate for quartz sleeve transmission reduction due to wastewater effluent fouling. The use of a higher quartz sleeve fouling factor will be considered only upon review and approval of independently verified data that has been collected

and analysed in accordance with protocols described in the NWRI *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse*. The data recorded for the determination of the validated fouling factor must be obtained by testing in secondary wastewater effluent utilizing the same lamp, quartz sleeve and cleaning system proposed by the UV manufacturer.

7. Independent validation for use of higher factors (lamp aging and sleeve fouling) must be submitted to the Engineer for consideration a minimum of fifteen (15) days prior to bid. The independent validation shall have oversight by a qualified registered professional engineer with knowledge and experience in testing and evaluation of UV systems as defined in the EPA UVDGM (Appendix C, Section C.3.3)
8. The system will be designed for complete outdoor installation.

## 2.4 SUBMITTALS

- A. Submit for review, shop drawings showing the following:
  1. Complete description in sufficient detail to permit an item comparison with the specification.
  2. Dimensions and installation requirements.
  3. Descriptive information including catalogue cuts and manufacturers' specifications for major components.
  4. Electrical schematics and layouts.
  5. Hydraulic calculations demonstrating compliance with the required hydraulic characteristics.
  6. Independent bioassay validation and dosage calculations demonstrating compliance with the specified RED requirements.
  7. Lifetime disinfection performance guarantee.

## 2.5 WARRANTIES

- A. Equipment:

The equipment furnished under this section will be free of defects in material and workmanship, including damages that may be incurred during shipping for a period of 12 months from date of start-up.

B. UV Lamps:

The UV lamps will be warranted for a minimum of 15,000 hours when operated in automatic mode, prorated after 9,000 hours. On/off cycles are limited to an average of four (4) per day accumulated over the guaranteed life of the lamp.

C. Lamp Drivers:

Lamp drivers will be warranted for 10 years, prorated after 1 year.

D. UV Intensity Sensors:

UV Intensity Sensors will be warranted for 10 years.

## 2.6 MANUFACTURER

- A. The physical layout of the system shown on the contract drawings and the equipment specified herein are based on the TrojanUVSigna™, as manufactured by Trojan Technologies, London, Ontario, Canada. Alternate brands of equipment will be considered. See Part 1 above.
- B. If an alternate brand of UV equipment is proposed, the Contractor will demonstrate to the Engineer and the Owner that all requirements of materials, performance, and workmanship have been met or exceeded by the equipment proposed. Contractors proposing alternate manufacturers will be responsible for all costs associated with system evaluation and redesign including all electrical, mechanical and civil aspects of the installation.

## 2.7 DESIGN, CONSTRUCTION AND MATERIALS

A. General:

1. All UV Bank metal components in contact with effluent will be Type 316 stainless steel.
2. All wiring exposed to UV light will be Teflon™ coated.

B. Lamp Array Configuration:

1. The lamp array configuration will be in a staggered inclined arrangement.
2. The system will be designed for complete submersion of the UV lamps under all flow conditions including both electrodes and the full length of the lamp arc.
3. To maximize performance and ensure safety, bank light locks will be used in each bank to prevent potential short circuiting over the top of the lamps.
4. For any UV inclined system that does not contain UV bank light locks to prevent short circuiting, the system shall be supplied with 1 additional UV bank to compensate for short-circuiting over the top of the lamps.

C. UV Bank:

1. Each UV bank will consist of UV lamps, quartz sleeves and an automatic chemical/mechanical cleaning system mounted in a Type 316 stainless steel frame.
2. Each lamp will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal. To be considered as an alternate, lamp quartz sleeves that are open at both ends will be supplied with twice the amount of specified spare seals and lamps.
3. The closed end of the quartz sleeve will be held in place by a retaining O-ring. The quartz sleeve will not come in contact with any steel in the frame.
4. Each UV bank will contain a pre-formed Type 316 stainless steel wall on each side to prevent possible short-circuiting at the side walls of the reactor.

5. Each UV bank will contain light locks at the top of the bank to prevent short circuiting over the top of the lamps and maximize disinfection efficiency.
6. Each UV bank will be rated Type 6P. UV banks that are not Type 6P rated are not acceptable.
7. To minimize maintenance, equipment must be provided by the UV manufacturer to enable lifting a complete bank of lamps from the channel at once for inspection and/or servicing.

D. UV Lamps:

1. Lamps will be high intensity low pressure amalgam design. Lamps that are not amalgam will not be allowed.
2. The filament shall be significantly rugged to withstand shock and vibration.
3. Electrical connections for the lamp will consist of four (4) pins at one end of the lamp only. Lamp wiring shall be Teflon insulated stranded wire.
4. Lamps without maintenance coating or that do not have four (4) pins are considered instant-start and are not acceptable due to reduced reliability and increased maintenance and operating costs.
5. Lamps will be rated to produce zero levels of ozone.
6. The lamp shall withstand an average of four (4) on/off cycles per day without reducing lamp life, warranty or causing any damage to the lamp.
7. Lamps will be operated by electronic lamp drivers with variable output capabilities ranging from 30% to 100% of nominal power. The lamp assembly shall incorporate active filament heating to maintain a minimum lamp efficiency of 35% across varying water temperatures and between the minimum and maximum stated lamp power levels.

E. Lamp Plugs:



1. Each lamp plug will be accessible from the top of the UV bank to facilitate lamp removal without moving the UV banks or any other components.
2. Each lamp plug shall have provisions for a light emitting diode (LED) visual indicator that indicates on/off status for each lamp.
3. An integral safety interlock in the lamp plug will prevent removal of energized lamps.
4. The lamp plug shall be rated Type 6P.

F. Lamp Drivers:

1. Each lamp driver will independently power two (2) UV lamps. Failure of one lamp will not affect operation of the other lamp.
2. The lamp driver will have a power factor correction circuit to ensure minimum 99% power factor and less than 5% total harmonic distortion (THD) current at the maximum power level and nominal input voltage.
3. The lamp driver electrical efficiency will be minimum 95% at the maximum power level.
4. The lamp driver will be programmed-start type utilizing filament preheat followed by a high voltage pulse to ignite the lamp.
5. During lamp operation, variable filament heating current shall be provided according to a predetermined curve to maintain optimum filament temperature and amalgam temperature to ensure maximum lamp life and maintain a minimum lamp efficiency of 35% across varying water temperatures and between the minimum and maximum stated lamp power levels.
6. A ground fault in the output circuit shall be detected and communicated as a warning to the external controls system while the corresponding lamp operates undisturbed.
7. The communication protocol shall be Modbus implemented on an RS485 electrical interface.
8. Local visual diagnostic will be provided with LEDs for lamp driver status, lamp status (on, idle, preheat, fault), power and communication status.

9. For reliability and to facilitate trouble shooting, at a minimum, the following external indicators (protections, status, warnings and alarms) shall be provided: lamp status, driver status, ground fault, and communication time-out.

The lamp driver shall be UL, CE, and RoHS compliant.

G. Quartz Sleeves:

1. Quartz sleeves will be clear fused quartz circular tubing containing 99.9% silicon dioxide.
2. Sleeves will have minimum UV transmittance at 254nm of 87% (1mm wall thickness).
3. Sleeves will be open at one end only and domed at the other end.

H. Cleaning System:

1. An automatic in-situ cleaning system will be provided to clean the quartz sleeves using both chemical and mechanical methods. Wiping sequence will be automatically initiated with capability for manual override.
2. The cleaning system shall also incorporate an integrated debris removal device to clear the quartz sleeves of any large solids or debris to maximize the life of the chemical/mechanical cleaning system.
3. The wiper on the cleaning system shall be parked out of the effluent when not in use.
4. Cleaning systems that utilize a screw drive, or park the wiper in the effluent while not in use shall not be acceptable due to collection of debris in and around the wetted parts of the wiper.
5. The cleaning system will be fully operational while UV lamps and modules are submerged in the effluent channel and energized.
6. To minimize maintenance, UV System will be designed such that cleaning solution replacement can be performed while the UV Bank and lamps are in place and operational in the channel.

7. Cleaning sequence frequency will be field adjustable to enable optimization with effluent characteristics.
8. Cleaning system operation will be remote auto (default) or remote manual.
9. **The cleaning system will be provided with the required solutions necessary** for initial equipment testing and for equipment start-up.
10. The wipers shall travel the full length of the UV lamp arc. Designs in which the wipers only travel part way along the sleeves will not be acceptable.
11. The UV intensity sensor shall be cleaned utilizing the same chemical/mechanical cleaning method as that of the lamp quartz sleeves. UV intensity sensors that only utilize a mechanical means shall not be acceptable.

To be considered as alternate, systems that use only mechanical wiping must have the ability to periodically be cleaned out of channel using a chemical bath. Out of channel cleaning will include lifting slings, removable banks, cleaning tanks, agitation system and air compressors, as required. The UV manufacturer will be responsible for supplying all equipment including any equipment not specifically listed required to perform out of channel chemical cleaning. Contactor will be responsible for installation.

I. Flow Control System:

1. Level Control Weir – Effluent Control
  - a) To be located at the discharge end of the UV channel.
  - b) Weir will be designed to maintain the minimum channel effluent level required to keep lamps submerged at all times.
  - c) Weir to be constructed of Type 304 stainless steel.
2. Influent Control Gates –
  - a) To be located at the influent end of the UV channel.

- b) Gates are to be Fontaine 316 Stainless Steel Slide Gates, Series 25, embedded, or equal. See drawings.
- c) Gates are to be furnished with electric actuators, ME MXA EMO by Limitorque Flow Serve, 460 V, 3phase, or equal. Actuators shall be furnished with options necessary to control gates from a 4-20mA signal and for gates to provide continuous operation during power failure, and to operate as necessary to control flow to the UV system in all flow ranges.
- d) The gates with actuators are to be opened and closed based on the flow. The existing effluent flow meter at the plant is to be used for signal. The gates are to open and close as necessary to minimize energy costs while maintaining proper treatment of effluent. The operation of the system shall be in such a manner that during normal operation (less than 7 MGD) only one channel will be in operation and the second channel will go into operation automatically when the first channel approaches 90% of design flow for one channel. The operation of the two channels shall be controlled in such a manner that operation of the two channels will alternate automatically at least weekly even if the flow rate does not reach 10 MGD during the week. The proposed operation of the flow control and gate operation are to be described in detail in the shop drawing submittal.
- e) All panels required are to be NEMA 4X.
- f) All materials and labor necessary to connect the controls of the UV system to the existing flow meter shall be furnished and connected.

#### J. Light Locks

- 1. Light locks, two (2) per bank, will be provided to force effluent through the UV treatment zone maximizing disinfection performance.

2. The entire length of the lamp arc will remain submerged to maximize UV dose delivered to the effluent and to prevent any UV exposure above the water free surface.

K. Electrical:

1. All applicable electrical components will be UL-listed to ensure safety standards are met.
2. Each UV lamp within a bank will be powered from a Power Distribution Center.
3. UV Manufacturer to supply all cabling between lamps and drivers.
4. Each electronic lamp driver will power two lamps.
5. Power factor will not be less than 99% leading or lagging.
6. Electrical supply to each Power Distribution Center will be 480V, 3 phase, 4 wire + GND, 60 Hz, 31.7 kVA.
7. Electrical supply to the Hydraulic System Center will be 480V, 3 phase, 3 wire + GND, 60 Hz, 2.5 kVA
8. Electrical supply for the water level sensor will be provided by the PDC and be 12 Volt DC.
9. Electrical supply to the System Control Center will be 120V, 1 phase, 2 wire + GND, 60 Hz, 1.8 kVA
10. The UV System electrical panels furnished by the manufacturer are not provided with electrical disconnects. However, each electrical power supply shall be provided with a separate disconnect. See electrical drawings for additional information.
11. All work shall be done per National Electrical Code NFPA 70, Local Ordinances, meet requirements of Tennessee Department of Environment & Conservation, conform to applicable state and local building codes, conform to Fire Protection NFPA 72, and Life Safety Code NFPA 101. Contractor shall obtain inspections and permits required.

L. Power Distribution Center (PDC):

1. There shall be one PDC for each channel and it shall be configured for the lamps in that channel.
2. PDC enclosure material will be 304 Stainless Steel.
3. All internal components will be sealed from the environment.
4. All Power Distribution Centers are to be UL approved or equivalent.
5. An internal heater will be provided in the PDC to prevent condensation when the external temperature drops below the dew point.
6. Each PDC shall be able to electrically isolate each bank of lamp drivers and safely replace a lamp driver without de-energizing any other operating banks.

M. Hydraulic System Center:

1. The Hydraulic System Center (HSC) houses the components required to operate the automatic cleaning system and bank Automatic Raising Mechanism (ARM).
2. There shall be one HSC for each channel.
3. HSC enclosure material will be 304 Stainless Steel (Type 4X).
4. The HSC will contain hydraulic power unit complete with pump, fluid reservoir, manifolds, valves and filter.

N. Control and Instrumentation:

1. System Control Center (SCC) / Main Control Panel:
  - a) The monitoring, operation and control of the UV disinfection system is managed at the System Control Center (SCC) by a Allen Bradley (or equal) Compact Logix with a Beijer (or equal) 15" A15 (Outdoor 4X Rated) HMI screen.
  - b) The SCC is proposed to be installed outdoors and the operator interface shall be positioned out of or away from direct sunlight and shall include a sunshade. The operator interface screen will be designed for a rugged outdoor environment capable of operating at ambient temperatures between -30 Deg C and +70 Deg C with a high brightness

display (minimum 1000 Nit). HMI screen shall be certified for outdoor use (UL50E Type 4X Outdoor)

- c) The SCC shall control not only the UV equipment but the flow control to the system. The SCC shall control the automatic flow control gates at the influent of each channel. The SCC shall control the opening and closing of the gates based on the flow signals from the existing effluent flow metering. The wiring and conduit required to connect the existing flow meter to the SCC shall be included as part of the UV system. The SCC shall be able to control the required UV dose based on the flow. The system shall be capable of operating the system at 100% UV dose in the event of flow signal interruption and provide an alarm in such an event.
- d) Alarms will be provided to indicate to plant operators that maintenance attention is required or to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. The alarms will include, but not be limited to:
  - i) Individual Lamp Failure
  - ii) Multiple Lamp Failure
  - iii) Low UV Intensity
  - iv) Bank Communication Alarm
  - v) No flow signal
- e) The 100 most recent alarms will be recorded in an alarm history register and will be displayed when prompted.
- f) Mode of operation for UV Banks can be manual, automatic or remote.
- g) Elapsed time of each bank will be recorded and displayed on the display screen when prompted.
- h) A generator will be installed to operate this UV system in case of a power failure. The UV system and controls provided shall be compatible with the generator system as designed without any interruption of disinfection. Refer to electrical drawings for additional information.

- i) The UV System will be connected to the WWTP's SCADA system in the future. All components / features necessary so that the system can be connected in the future shall be supplied.
2. Low Water Level Sensor:
- a) The UV Manufacturer will provide one (1) low water level sensor for each UV channel.
  - b) During all modes of system operation (manual, automatic and remote), the water level sensor will ensure that lamps extinguish automatically if the water level in the channel drops below an acceptable level.
3. UV Intensity Sensors:
- a) A UV sensor will continuously monitor the UV intensity produced within each UV Bank.
  - b) The sensors will measure only the germicidal portion of light emitted by the lamps.
  - c) The UV sensor shall be factory-calibrated to US National Institute for Standards and Technology (NIST). Sensors requiring field-calibration are not acceptable.
  - d) The sensor shall be digitally calibrated to ensure calibration accuracy.
  - e) To ensure continuous disinfection, the sensor shall be accessible without shutting down the system, lifting a bank/module or removing lamps.
  - f) Sensors will be designed to provide UV intensity data for dose monitoring and control functions. Dose pacing program will enable use of measured UV intensity along with flow rate and UVT to determine the delivered dose during operation.
  - g) Sensors will be designed such that reference sensor readings can be taken without interrupting disinfection and without removing UV lamps, banks/modules or sleeves.
4. Dose-Pacing:



- a) A dose-pacing system will be supplied to modulate the lamp UV output in relationship to a 4-20 mA DC signal from an effluent flow meter (supplied and installed by Others) and UV intensity sensors.
- b) The system to be dose-paced such that as the flow and effluent quality change, the design UV dose is delivered while conserving power.
- c) The dose-pacing system will allow the operator to vary the design dose setting. Logic and time delays will be provided to regulate UV Bank ON/OFF cycling.

O. UV Bank Lifting Device:

- 1. The lifting device for UV Banks will be supplied by the UV Manufacturer.
- 2. An Automatic Raising Mechanism (ARM) will be designed and supplied to facilitate lifting a UV bank from the channel without use of ancillary equipment.
- 3. The ARM will be integrated into the UV Bank for simple and seamless operation.
- 4. The UV Bank will be raised from the channel for easier access and maintenance.
- 5. The ARM design will provide access to components without having to break electrical connections thus reducing wear on connectors.

P. Spare Parts:

The following spare parts and safety equipment will be supplied.

- 1. 8 UV Lamps
- 2. 8 Quartz Sleeves
- 3. 8 Lamp Wiper Seals
- 4. 1 Operators Kit that includes UV-resistant face shield, gloves and cleaning solution.

5. To be considered as an alternate, systems that require more lamps than specified, the UV manufacturer will provide spares in the amount equal to the quantities listed plus an additional quantity equal to the percentage of lamps required over and above the number of lamps specified.

### **3.0 EXECUTION**

#### **3.1 INSTALLATION**

Installation shall be completed in accordance with contract drawings, manufacturers' shop drawings, instructions and installation checklist. If requested by manufacturer, the Contractor is to complete an "Installation Checklist" furnished by manufacturer and submit to engineer and manufacturer at least two (2) weeks prior to date requested for commissioning. Photographs illustrating site readiness are to be furnished with the checklist. The Contractor assumes all responsibility for the installation readiness of the UV system to the manufacturer. Any labor, materials and test apparatus necessary for completing the installation shall be furnished by the Contractor at no additional cost to the Manufacturer or the Owner. It is the responsibility of the contractor to coordinate start up and commissioning of the equipment. The contractor is to advise the owner at least one week in advance of the dates when these will occur.

The existing sewer plant must remain in continuous service during the construction of this project. Temporary bypass piping shall be installed between the manhole that is located between the clarifiers and the effluent structure prior to excavating for the new UV structure. The bypass piping shall have the same hydraulic capacity as the existing piping that is now in place and shall not require any aid of the owner to remain in continuous service. The bypass piping shall be gravity flow (unless otherwise approved by Owner). The contractor shall be responsible for any overflows (including any damage or enforcement action levied against the owner as a result) that occurs as a result of the bypass piping or construction. The contractor is to submit a plan to the owner and engineer for approval prior to installation.

### 3.2 MANUFACTURER'S SERVICES

- A. The manufacturer shall assist the contractor with the installation of the equipment.
- B. The manufacturer will provide Start-up and field testing. Once the manufacturer has assisted the contractor with the installation the manufacturer will provide field testing of the equipment and commission the equipment. The manufacturer shall provide a Certified Service Technician for services. The contractor shall give at least a 48 hour notice to the engineer and the owner and a representative of each shall be present when the field testing is conducted. The manufacturer shall provide a check list and a report to the owner and engineer following the testing documenting that there are no deficiencies and that the equipment is operating as designed. If there are any deficiencies the corrections shall be made promptly and the equipment shall be retested. This includes the State of Tennessee Electrical Inspection. All control apparatus shall be properly calibrated and adjusted.
- C. The manufacturer shall provide a certified service technician to provide operator training to the owner's representatives. The manufacturer shall schedule this training with the owner well in advance so that the plant operators of the owner can be present. 24 hours of on-site training shall be conducted within a few days of commissioning the equipment. One more day (8 hours of on-site) training shall be provided at the WWTP approximately 6 months after the commissioning date as scheduled by the owner. The hours of "on-site" hours do not include any travel time. The training shall be done so that all shifts of the workers can be present. The Contractor shall notify the Engineer prior to performance of tests and the Engineer shall be present. Any defects identified during the tests shall be promptly corrected and the tests repeated.

Commercial testing, at the factory, shall be required and include the following:

1. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase and hertz.

2. The stator motor leads shall be tested for integrity using a megohmmeter at the highest setting.
3. Pump shall be allowed to run dry to check for proper rotation.
4. Discharge piping shall be attached; the pump submerged in water and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced.
5. The pump shall be removed from the water, megohmmeter tested again, dried and the motor housing filled with dielectric oil.

Field Testing by Contractor shall be performed include the following:

6. The pump basin shall be cleaned from all construction debris or debris that may cause damage using portable pump or other method prior to testing pumps.
7. The pumps shall be visually inspected to confirm that it is built in accordance with the specification as to HP, voltage, phase and hertz.
8. Each pump shall be started using floats and run. Operating flow rate shall be calculated and compared to design points. Amperage readings shall be taken on each leg for each pump.
9. Rail system for pumps shall be checked to determine if pumps can be removed easily and that they are aligned properly.

#### *PART 5 - WARRANTY*

The UV system or any part thereof shall be warranted against defects in material or workmanship within one year from date of installation or 18 months from date of manufacture, whichever comes first, and shall be replaced at no charge with a new or manufactured part, F.O.B. factory or authorized warranty service station. The warranty shall not assume responsibility for removal, reinstallation or freight, nor shall it assume responsibility of incidental damages resulting from the failure of the UV system to perform.

#### *PART 6 - PAYMENT*

The UV System will be part of the lump sum payment for the wastewater treatment plant upgrade.

#### *END OF SECTION*

## **SECTION 13122 – PRE-ENGINEERED METAL BUILDING / COVER**

### *PART 1 – GENERAL:*

#### *SCOPE:*

The scope of the work described in this section is for a pre-engineered metal cover, including steel framing, for the UV system. The cover will include erection, labor, and materials to provide a clear span cover over the equipment. There will be no walls or doors but will include the roof only.

### *PART 2 – MATERIALS:*

#### *BUILDINGS:*

The cover shall be 60' 0" long and 30'0" wide with 2' overhang on all sides. The building must have a 12' high minimum clearance inside the building and a minimum of 14'0" eave height.

The cover shall be a pre-engineered, clear span, metal building with a gable symmetrical roof and a 2:12 roof pitch. The building manufacturer shall be A&S Building Systems, Butler Building Systems, Kirby Building Systems, Metallic Building Systems, Star Building Systems, Varco-Pruden Building Systems, or equal. The building shall meet the requirements of the 2012 International Building Code, or latest edition. The building shall meet seismic design requirement of IBC and shall be designed for the following loads:

- 20 lbs full live load with no reductions
- 15 lbs ground snow load (Importance factor 1.0)
- 3 lbs collateral load
- 115 MPH wind load (Importance factor 1.0)

The metal building/cover must be designed by an Engineer, licensed by the State of Tennessee. Stamped drawings must be furnished to the Owner with shop drawings and shall include foundations, anchor bolt, erection and all other components of building. The submittal shall also include 20-year panel finish guarantee, 20-year perforation guarantee and other applicable certificates from manufacturer.

The Roof panels shall be a 24-gauge Galvalume Screw Down roof panel with stainless steel capped screws and guarantee by metal building manufacturer. Snow jacks shall be included.

All structural steel shall be primed with red oxide paint by the metal building

manufacturer. The building shall be clear span.

There shall be 6" VRV (vinyl reinforced vinyl) metal building insulation located in the roof.

The gutters, downspouts, rake/gable trim, and eave trim, shall be furnished and installed. Downspouts are to be hard piped to daylight.

*See Section 02200, 03001 and structural drawings for foundations. The cover is bid as an alternate. The foundations are part of the base bid and shall be installed even if the cover is not awarded.*

The building framing shall be done in such a manner so that the stairs can be installed at location where designed without obstruction by any structural members. Portal framing is to be utilized on West Side of Building to avoid cross-bracing. Cross-bracing is permitted on the other three sides if it can be accomplished without interference with stairways.

#### *PART 3 – EXECUTION:*

All erection, labor, and equipment should be included for this scope of work. Work shall be done in accordance with building manufacturer's specifications and applicable building codes.

Keep all materials clean and protected.

All concrete work shall be done in accordance with applicable American Concrete Institute (ACI) requirements, and local building codes. See section 03001.

#### *PART 4 – PAYMENT:*

Payment for the building, including foundation, sitework, etc. shall be part of the lump sum bid for the project.

END OF SECTION

**GREENEVILLE WWTP**

**TEST RESULTS**

**CERTIFICATE OF ANALYSIS  
Final Report**

**Project Name:** Greeneville Water Commission  
**Contact:** Karen Wilholt  
**Address:** Denzil Bowman WWTP  
4520 Old Asheville Highway  
Greeneville, TN 37743

**Trojan Sales:** Ben Zwart  
**Local Trojan Rep:** ---  
**Engineer:** ---  
**Sample #:** 18-0055 & 18-0056

**Telephone:** 423-798-2035  
**Email:** kwillholt@gwctn.org

<b>Received Date/Time:</b> April 5, 2018 10:45am	<b>Treatment Process:</b> Activated Sludge
<b>Analysis Date:</b> April 5-6, 2018	<b>Weather Conditions:</b> ---
<b>Release Date:</b> April 6, 2018	<b>Disinfection Limit:</b> 126 E. coli/100mL 30 day geometric 487 E. coli/100mL daily max.

LAB SAMPLE NO.	SAMPLE IDENTIFICATION	SAMPLE DATE/TIME (M/D/Y)	RECEIVED TEMP. (°C)	UVT (%/cm)	UVT FILTERED (%/cm)	TSS (PPM)
18-0055	Collimated Beam Sample	04/03/18 11:30am	11.5	80	80	5.0
18-0056	Particle Size Analysis Sample	04/03/18 11:30am	11.5	---	---	---

**COLLIMATED BEAM RESULTS**

Dose (mWs/cm <sup>2</sup> )	18-0055 E. coli/100mL
0	30000
5	2600
10	40
20	1
40	1
80	<2

**DESCRIPTION OF ANALYSES**

**UVT (UV Transmittance)**

The percentage of germicidal UV light that is able to penetrate through 1cm of water sample at 254nm. The higher the UVT value measured the more effective a UV system will be. UVT can be reduced by iron, organic dyes, tannins, humic acids.

**UVT Filtered**

The percentage of germicidal UV light that is able to penetrate through a sample of water after it has passed through a 1.2µm Glass Fiber Filter.

**TSS (Total Suspended Solids in PPM – Parts-Per-Million or mg/L -- milligrams per Liter)**

The weight measurement of all suspended matter larger than 1.2µm for a predetermined volume of water.

**Collimated Beam**

Determines the UV dose necessary to disinfect wastewater effluent to legislated permit levels or lower for specified target microorganisms.

**Comments:**

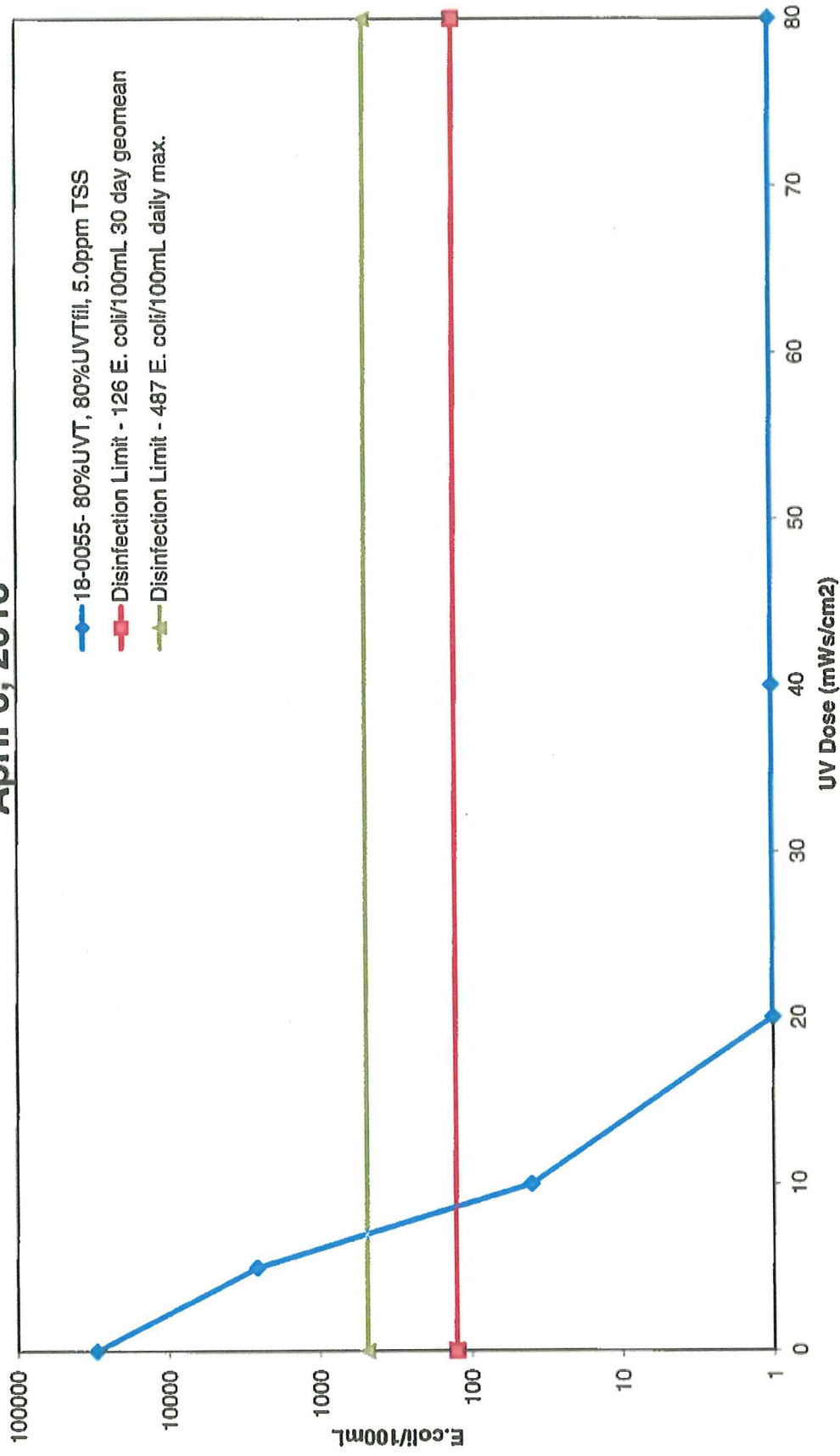
*Brian Petri*

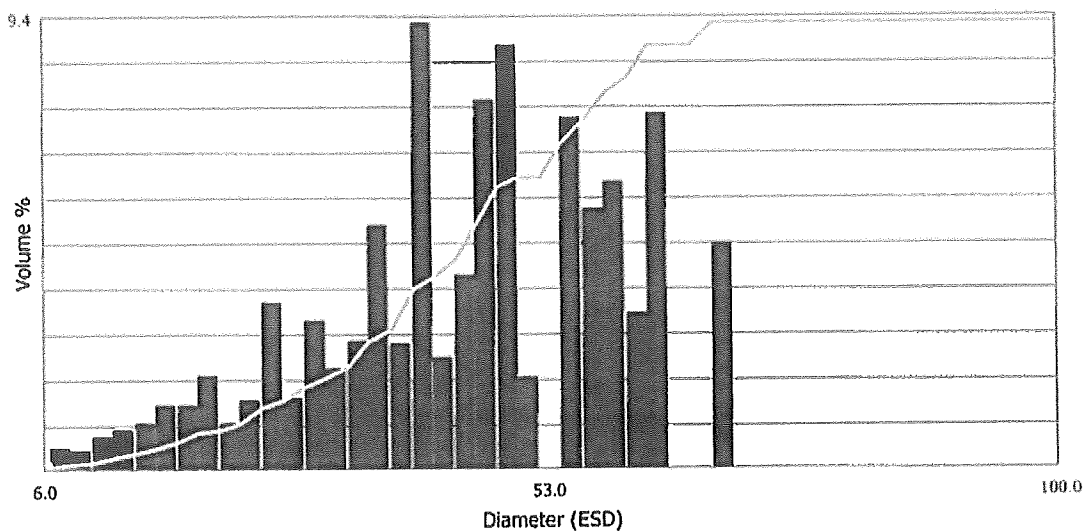
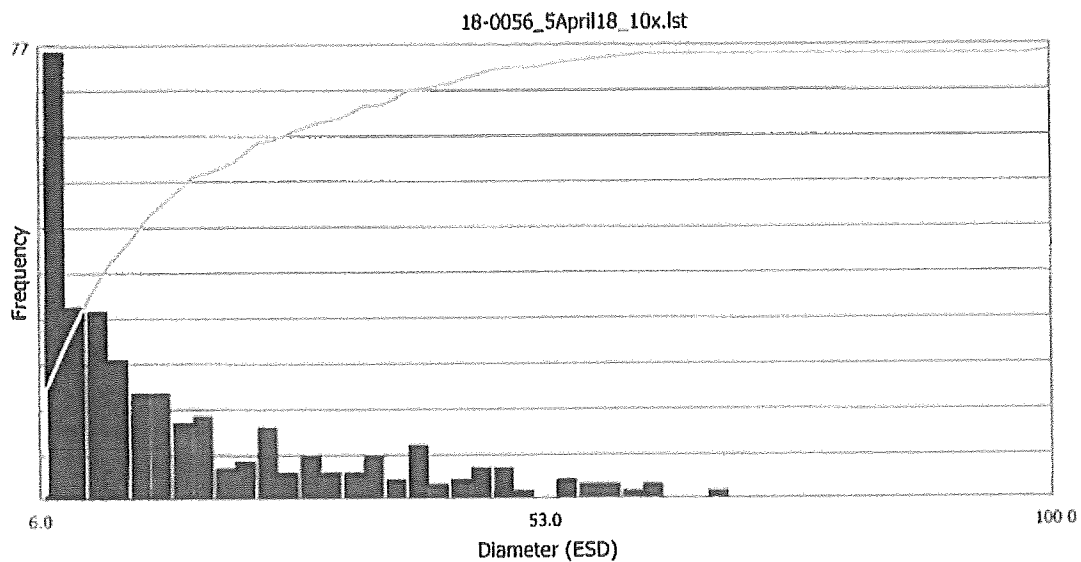
Certified by Brian Petri, Ph.D.

Validation & Research Services Manager



# Greeneville, TN April 6, 2018





Count	317 of 317			
Particles / ml	1580			
Summary Stats	Mean	Min	Max	StdDev
Diameter (ESD)	18.76	6.01	68.15	13.84
Length	23.17	6.47	88.94	16.66
Width	12.88	0.68	51.28	10.91
Filter	Count	Volume %		
6-10um	110	0.75		
10-20um	105	5.01		
20-30um	41	9.32		
30-40um	25	15.78		
40-50um	24	32.68		
50-60um	8	20.93		
60-70um	4	15.54		
70-80um	0	0.00		
80-90um	0	0.00		
90-100um	0	0.00		

UV Transmittance measured by Greeneville WWTP Staff

Date	Result	Meter Zero #
2/28/2018	76	Unknown
3/5/2018	81	99
3/6/2018	78	96
3/7/2018	76	96
3/8/2018	78	98
3/9/2018	76	96
3/12/2018	78	98
3/13/2018	78	98
3/14/2018	80	101
3/15/2018	78	98
3/16/2018	75	98
3/19/2018	75	97
3/20/2018	72	97
3/21/2018	79	97
3/22/2018	76	98
3/23/2018	77	99
3/26/2018	82	100
3/27/2018	79	98
3/28/2018	81	100
3/29/2018	81	99
4/2/2018	80	99
4/3/2018	75	96
4/4/2018	77	97
4/5/2018	78	98
4/6/2018	79	98
4/9/2018	81	97
4/10/2018	79	96
4/11/2018	80	97
4/12/2018	80	98
4/13/2018	80	97

Received mud from water plant

Received mud from water plant